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ABSTRACT

This study used data on 1992 high school graduates from the National Education Longitudinal Study of 1988 (a survey that began with eighth graders in 1988 and followed them every two years through 1994) to examine the critical junctures when at-risk high school graduates are most likely to leave the pipeline to college enrollment, and to identify factors that increase their chances of successfully navigating the enrollment pipeline. An at-risk student was defined as having risk factors such as being from a single parent household, having an older sibling who dropped out of high school, and earning low grades between sixth and eighth grades. Highlights of the findings include: about 58 percent of graduates had one or more risk factors; of these, 30 percent successfully navigated the pipeline to college enrollment; at-risk students differed most from counterparts in their educational aspirations and academic preparation; and academically prepared at-risk students were much less likely than counterparts to take an entrance exam. After an introductory chapter, two chapters detail data and definitions and provide an overview of students at risk. The following two chapters present findings on the pipeline to a four-year college and compare at-risk students regarding completion of math courses, help received in the college application process, and level of school involvement of students, parents, and peers. Appended are a glossary, technical notes, and supplementary tables. (DB)

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Statistical Analysis Report December 1997

Confronting the Odds: Students At Risk and the Pipeline to Higher Education

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HIGHLIGHTS

The purpose of this report is twofold. First, it aims to understand the critical junctures in the pipeline to college enrollment where at-risk high school graduates leave at substantially higher rates than their counterparts not at risk. Second, it identifies factors that contribute to at-risk students' successful navigation of the pipeline to college enrollment.

Students at risk were defined as 1992 high school graduates who had risk characteristics that increased their chances of dropping out of high school. These included being from a single parent household, having an older sibling who dropped out of high school, changing schools two or more times other than the normal progression (e.g., from elementary to middle school), having C's or lower grades between sixth and eighth grades, being from a low socioeconomic status (SES) family, or repeating an earlier grade.

- About 58 percent of 1992 high school graduates had one or more risk factors; 32 percent had one risk factor, 16 percent had two, and 9 percent had three or more (table 1).

The pipeline analysis compares students at risk with their counterparts not at risk according to their progression through five steps to college enrollment. The five steps that make up the college pipeline include: aspirations for a bachelor's degree (step 1), academic preparation for college (step 2), taking entrance exams (step 3), applying to college (step 4), and enrolling (step 5). The proportion of students at each step are those who completed all the preceding steps.

PIPELINE TO COLLEGE

- Among 1992 high school graduates with no risk factors, 58 percent successfully navigated the pipeline to enrollment in a four-year college, compared with 30 percent of students at risk (figure 1).
- At-risk students most differed from their counterparts not at risk in relation to their educational aspirations (step 1) and academic preparation (step 2). Just over half (56 percent) of at-risk students aspired to a bachelor's degree in the tenth grade, compared with four out of five students (81 percent) not at risk. About 44 percent of at-risk students progressed to step 2 (were at least minimally prepared academically to attend a four-year college), compared with 75 percent of students not at risk.

- Even among students who completed step 2 (were academically prepared), at-risk students were much more likely *not* to complete step 3 (take an entrance exam) than students not at risk (9 percent versus 3 percent) (figure 2).
- Among students who got as far as taking entrance exams, 13 percent of at-risk students did not apply to college (step 4), compared with 9 percent of those not at risk.
- Among students who completed the pipeline through step 4 (applied to one or more four-year colleges), about 16 percent of at-risk students did not enroll (step 5), compared with 12 percent of students not at risk.

COMPARISONS AMONG AT-RISK STUDENTS

At-risk students who progressed through the college pipeline and enrolled in a four-year college were compared with their at-risk peers who either enrolled in a subbaccalaureate degree institution or did not pursue further education. Comparisons were made in three areas: completion of math "gatekeeping" courses, obtaining school assistance in applying to college, and activities and behaviors associated with student, parent, and peer engagement in school activities. The analysis was limited to at-risk students who completed the first two steps of the pipeline (aspired to a bachelor's degree and were at least minimally prepared for admission to a four-year college).

Math Course Taking

- Among at-risk students who aspired to a college degree and were academically prepared, about two-thirds (64 percent) of those who enrolled in a four-year college completed at least one advanced math course (such as calculus), compared with about one-third who enrolled in other postsecondary education (36 percent) or who did not enroll at all (31 percent) (table 9). There was no measurable difference in the proportion of students who took advanced math courses between those enrolled in other postsecondary education and those who did not enroll.

School Assistance in Application Process

- At-risk students who enrolled in a four-year college were more likely to report receiving help from school personnel in filling out their application (56 percent) than either those who enrolled in other postsecondary education (44 percent) or those who had never enrolled (43 percent) (table 10).
- At-risk students did not differ, however, with respect to taking a special course offered by the school to help them prepare for the college entrance exams relative to their postsecondary enrollment outcomes.

Student, Parent, and Peer Engagement

- The rate at which students participated in two or more extracurricular activities distinguished students who enrolled in a four-year college (48 percent) from those who had never enrolled in postsecondary education (34 percent) (table 11).
- The frequency with which parents reported discussing school-related matters with their child distinguished students who enrolled in a four-year college from those who either enrolled in other postsecondary education or did not enroll (table 12). For example, four-year college enrollees' parents were less likely to report having few or no discussions (13 percent) than were students who enrolled in other postsecondary education (20 percent) or those who had never enrolled (24 percent).
- The number of students' friends with plans to attend a four-year college was strongly associated with enrollment outcomes (table 13): students who enrolled in a four-year college were much more likely to report that all or most of their friends planned to attend (80 percent), compared with those who enrolled in other postsecondary education (60 percent) or who never enrolled (49 percent).

FOREWORD

This report is part of the Postsecondary Education Descriptive Analysis Reports (PEDAR) series. The PEDAR series consists of reports that focus on postsecondary education policy issues, taking advantage of a variety of education data sources, especially recently completed data collections. Other reports in the series include: *Undergraduates Who Work While Enrolled in Postsecondary Education: 1989–90* (NCES 94-311); *Characteristics of Students Who Borrow to Finance Their Postsecondary Education* (NCES 95-310); *Minority Undergraduate Participation in Postsecondary Education* (NCES 95-166); *Profile of Older Undergraduates: 1989–90* (NCES 95-167); *Profile of Part-Time Undergraduates in Postsecondary Education: 1989–90* (NCES 95-173); *Packaging of Undergraduate Student Financial Aid: 1989–90* (NCES 95-313); *How Low Income Undergraduates Financed Postsecondary Education: 1992–93* (NCES 96-161); and *Nontraditional Undergraduates: Trends in Enrollment from 1986 to 1992 and Persistence and Attainment Among 1989–90 Beginning Postsecondary Students* (NCES 97-578).

This report compares 1992 high school graduates who were "at risk" of dropping out of high school with their counterparts not at risk to determine how well each group progressed through five important steps leading to college enrollment. These steps were defined in terms of a "pipeline" to college enrollment and include: aspirations for a bachelor's degree (step 1), academic preparation for college (step 2), taking entrance exams (step 3), applying to college (step 4), and enrolling in college (step 5). Students were considered at risk if they had one or more of the following characteristics: were from a single parent household, had an older sibling who dropped out of high school, changed schools two or more times other than the normal progression (e.g., from elementary to middle school), had C's or lower grades between sixth and eighth grade, were from a low SES family, or repeated an earlier grade.

The data used for this analysis were drawn from the National Education Longitudinal Study of 1988 (NELS:88/94), a survey that began with eighth graders in 1988 and followed them every two years through 1994. The analysis was limited to 1992 high school graduates.

The percentages and means presented in this report were produced using the public access NELS:88/94 Data Analysis System (DAS). The DAS is a microcomputer application that allows users to specify and generate their own tables from the NELS data. The DAS produces design-adjusted standard errors necessary for testing the statistical significance of differences shown in

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We are grateful to all the reviewers of this report whose insights and helpful criticism strengthened the final product. Ellen Bradburn from Education Statistics Services Institute provided a comprehensive substantive and methodological review. Robert Burton and Mike Ross from NCES, and David Bergeron from the Office of Postsecondary Education (OPE), reviewed the final report.

the tables. Additional information about the DAS, and how it may be obtained, is included in appendix B of this report.

We hope that the information provided in this report will be useful to a wide range of interested readers, and that the results reported here will encourage others to use the NELS data.

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INTRODUCTION

Getting a college education has become increasingly important in order to participate fully in today's labor market. The size of the blue-collar job sector has declined markedly over the last two decades.[1] At the same time, there has been a parallel decline in entry-level wages, and the wage drop for high school graduates entering the labor force has been more than three times that of college graduates (in constant dollars).[2]

In the past, students who either dropped out of high school or entered the labor market immediately after high school graduation may have relied on getting relatively well paying entry-level manufacturing jobs. However, now that the economy demands a more technologically sophisticated labor force, these youth may have limited opportunities for economic advancement unless they continue their education beyond high school.

These changes may have especially adverse consequences on students who are characterized as "at risk." These are students whose family background or early educational experiences place them at greater risk of dropping out of high school. For those who manage to graduate from high school, at-risk students are much less likely to pursue further education. For example, among 1988 eighth graders in the lowest socioeconomic status (SES) quartile, about one-third enrolled in some form of postsecondary education by 1994, compared to most (88 percent) of the students in the highest SES quartile.[3]

BACKGROUND

Until recently, much of the research on "at-risk" populations has concentrated on identifying exactly who is at risk.[4] That is, outside of ability, what are the factors that distinguish students who drop out or fail in school from those who do not? However, the focus has

[1]L. Mishel and J. Bernstein, *The State of Working America* (New York, NY: Economic Policy Institute, M.E. Sharp, 1994).

[2]Ibid. For example, according to Mishel and Bernstein, the entry-level hourly wage for high school graduates in 1993 dollars declined from $8.82 in 1973 to $6.61 in 1993. College graduates' entry-level hourly wage declined from $12.55 to $11.67 for the same time period.

[3]M. McMillen and P. Kaufman, *Dropout Rates in the United States: 1994* (NCES 96-863) (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 1996).

[4]P. Kaufman and D. Bradby, *Characteristics of At-Risk Students in NELS:88* (NCES 92-042) (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 1992).

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subsequently shifted to understanding why certain at-risk students exhibit resiliency and do well in school despite significant disadvantages. For example, a study conducted by Finn (1993) revealed that higher achieving at-risk students were more engaged in their school life from the very start of their education.[5] These students were more likely to have attended kindergarten than their lower achieving peers, and later in their school life, exhibited stronger participatory behaviors both inside and outside the classroom. As eighth graders, these students attended class more often, came to school more prepared, did more homework, and participated in extracurricular activities at higher rates.

More recently, Chen and Kaufman (1997) analyzed the influence of "protective" behaviors exhibited by successful at-risk students in high school.[6] In their study "success" was defined as graduating from high school, and the protective behaviors were ones that lowered the odds of dropping out. These behaviors were defined within three domains: family, individual, and peer associations. A number of these variables significantly reduced the odds of dropping out of high school independent of SES and race–ethnicity.

The study reported on here builds on Chen and Kaufman's research by beginning with a "resilient" population of at-risk students—those who graduated from high school—and tracking their progress through the "pipeline" to college enrollment. The purpose is twofold: first, to determine junctures in the pipeline to college enrollment where at-risk students leave at substantially higher rates than their counterparts not at risk; and second, to compare at-risk students with different postsecondary enrollment outcomes in order to identify factors that may contribute to their successful navigation of the pipeline to college enrollment.

To set the context, the analysis first compares students who are at risk with those who are not. It is loosely modeled on the "pipeline" study developed by the National Science Foundation (NSF), which identifies various junctures in the pipeline to attaining a college degree in mathematics, science, or engineering.[7] In the current study, the pipeline represents the path from high school to enrollment in a four-year college.[8] The pipeline has five major junctures: having aspirations for a bachelor's degree, academic preparation for college, taking entrance exams, applying to college, and enrolling.

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[5]J. Finn, *School Engagement and Students At Risk* (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 1993).

[6]X. Chen and P. Kaufman, "Risk and Resilience: The Effects on Dropping Out of High School," a paper presented at the American Education Research Association (AERA) meeting, Chicago, 1997.

[7]National Science Foundation, National Science Board, *Science and Engineering Indicators—1995* (Washington, D.C.: U.S. Government Printing Office, 1995).

[8]In this report, the term "four-year college" refers to any four-year postsecondary institution that offers a bachelor's degree program. The first postsecondary enrollment, if any, is used to determine enrollment in such a program.

The second part of the analysis compares at-risk students who progressed through the college pipeline and enrolled in a four-year college with their at-risk peers who either enrolled in a subbaccalaureate degree institution, such as a community college, or who did not pursue further education (at least within two years) after high school. Comparisons are made in three areas: math course taking, school assistance in the applying to college, and activities and behaviors associated with school engagement.

DATA AND DEFINITIONS

STUDY SAMPLE

The data used for this analysis are drawn from the National Education Longitudinal Study of 1988 (NELS:88/94), a survey that began with eighth graders in 1988 and followed them every two years through 1994. The sample was limited to 1992 high school graduates.

The first part of the analysis is based on all 1992 high school graduates, comparing students who are at risk with their counterparts who are not at risk according to how well they navigated through the pipeline to college enrollment. The second part of the study is based entirely on students at risk and comparisons are made among at-risk students with different postsecondary enrollment outcomes.

WHO IS AT RISK?

Previous studies conducted on the base-year and first follow-up NELS surveys (eighth and tenth graders) identified many factors that are associated with the probability of school failure and dropping out.[9] As one might expect, these factors are often highly correlated with students' SES. However, Chen and Kaufman identified five factors that increased the odds of dropping out of high school even after controlling for SES and race–ethnicity.[10] These risk factors included being from a single parent household, having an older sibling who dropped out of high school, changing schools two or more times other than the normal progression (e.g., from elementary to middle school), having poorer than average grades, and repeating an earlier grade. While it is true that college enrollment rates vary according to racial–ethnic groups,[11] there are a number of other factors including socioeconomic status that are associated with these trends. For example, Hauser (1992) reported that black students were more likely to attend college than whites once SES was taken into consideration.[12]

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[9]P. Kaufman and D. Bradby, *Characteristics of At-Risk Students in NELS 88*

[10]X. Chen and P. Kaufman, "Risk and Resilience."

[11]D. Koretz, "Trends in Postsecondary Enrollment of Minorities," RAND, Eric Document # ED328112 (1990).

[12]R. Hauser, "Trends in College Entry Among Whites, Blacks, and Hispanics, 1972–1988," Eric Document # ED343987 (1992).

This analysis, therefore, used the same definition of risk that was developed by Chen and Kaufman which controlled for racial–ethnic group differences. All of the risk factors were identified in 1988 (when students were in the eighth grade) with the exception of having older siblings who dropped out of high school, which was asked in 1990. In summary, students were considered at risk if they had one or more of the following characteristics:

- Lowest SES quartile;
- Single parent family;
- Older sibling dropped out of school;
- Changed schools two or more times;
- Average grades of C's or lower from sixth to eighth grade; and
- Repeated a grade.

The analysis also distinguished students' level of risk by identifying those at low risk (one risk factor), moderate risk (two risk factors), and high risk (three or more risk factors).

PIPELINE TO COLLEGE

The pipeline is a concept used to define the major junctures in the pathway to college enrollment. It begins with a student's desire to continue her or his schooling beyond high school and ends with matriculation in a four-year college. While the steps primarily concern the track to a four-year college, the postsecondary status of students who did not follow this path is also presented.

Step 1: Aspirations

Students' educational aspirations are highly correlated with their eventual attainment.[13] Moreover, the differences in aspirations between students from low-SES backgrounds and their more advantaged peers are also well known.[14] Among 1988 eighth graders, for example, less than half (42 percent) of low-SES students aspired to a bachelor's degree, compared with 64 per-

[13]S.L. Hanson, "Lost Talent: Unrealized Educational Aspirations and Expectations Among U.S. Youths," *Sociology of Education* 67 (1994): 159–183.

[14]See U.S. Department of Education, National Center for Education Statistics, *National Education Longitudinal Study 1988–1994 Descriptive Summary Report* (Washington, D.C.: 1996).

cent and 89 percent of middle- and high-SES students.[15] Thus, socioeconomic group differences in student aspirations emerge well before students begin high school.

For this analysis, students' tenth-grade aspirations signal the starting point of the pipeline to college. Tenth-grade aspirations were chosen over those reported either in the eighth grade or the twelfth grade because in tenth grade students probably have a better idea of what it takes to prepare for college than they do in eighth grade, and unlike twelfth graders, they still have time to take the classes required to enroll.

Step 2: Academic Preparation

Obviously, if students are not prepared academically for further education, it is highly unlikely that they will advance to higher education immediately after high school. To identify students who are academically prepared to enroll in college, this study draws upon recent research conducted by Berkner and Chavez (1997). Their study addressed the issue of college access and choice especially for low-income and racial–ethnic minority students.[16] In doing so, they developed an index that identifies whether or not students are "qualified" for admission to a four-year college. The index is a composite measure of academic qualification based on several criteria including rank in class, ACT/SAT scores, high school grades, and the 1992 NELS math and reading test composites. Minimal qualification was based on meeting at least one of the following criteria: ranked at the 54th percentile or higher in graduating class; a grade point average of at least 2.7 in academic courses; a combined SAT score of 820 or higher (or ACT score of 19 or higher); and a score at the 56th percentile or higher on the 1992 NELS math and reading composite test. Students who met or surpassed any one of these criteria were identified as being at least minimally prepared academically for college enrollment. If a student did not meet the minimal academic criteria, but had enrolled in a four-year college, the student was also classified as academically prepared (about 10 percent of enrollees).[17]

Steps 3 and 4: Entrance Exams and College Application

One of the most crucial junctures in the transition from high school to college, especially for students who are at least minimally prepared academically, is making the necessary prepara-

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[15]Ibid.

[16]L. Berkner and L. Chavez, *Access to Postsecondary Education for the 1992 High School Graduates* (NCES 98-105) (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 1998).

[17]This coding differs from the Berkner and Chavez report, which characterized these students as marginally or not qualified.

tions. Most of these students would be accepted to at least one four-year college if they took entrance exams and applied.[18]

Step 5: Enrollment

Taking the necessary steps to apply to a postsecondary institution does not necessarily guarantee admittance and matriculation, however. A student must meet the qualifications of the specific institution(s) to which he or she applied and have the resources to attend. Presumably most of those who were not accepted did not meet the requirements for admission. This analysis is limited to the first postsecondary enrollment, if any, in determining enrollment in a four-year college.

COMPARISONS WITHIN THE AT-RISK POPULATION

The second part of the analysis is concerned with distinguishing at-risk students who navigated the pipeline to a four-year college from their peers who did not. The following describes the three areas in which they are compared.

Math Course Taking

The sequence of math courses students take in high school may greatly influence their future opportunities to enroll in higher education.[19] Certain math classes are considered "gatekeeping" courses both for enrollment in four-year colleges and for entering quantitative fields of study.[20] Most universities require applicants to take three years of high school math including algebra I and II and geometry. In addition, calculus is greatly encouraged and is also a prerequisite for math and science majors.[21] To examine the math course taking of at-risk youth who enrolled in college with their counterparts who did not, this study used a course level index based on the NELS high school transcript data. University of Michigan researchers originally constructed the index to determine the highest sequence of math courses that students completed in high school.[22] The index is aggregated to four levels of course taking: low level (including no math, nonacademic or low-academic courses); middle level (at least two years including algebra

[18]L. Berkner and L. Chavez, 1998.

[19]D.L. Stevenson, K.S. Schiller, and B. Schneider, "Sequences of Opportunities for Learning," *Sociology of Education* 67 (1994): 184–189.

[20]J. Oakes, *Multiplying Inequalities* (R-3928-NSF) (Santa Monica, CA: RAND, 1990).

[21]Ibid.

[22]D.T. Burkham, V.E. Lee, and B.A. Smerdon, *Mathematics Coursetaking and the NELS:88 Transcript Data*, unpublished report for NCES, 1996.

I and geometry); high level (completed algebra II); and advanced course taking (completed algebra III, calculus, trigonometry, analytic geometry, or other advanced courses).[23]

School Assistance With the College Application Process

At-risk students are often the first generation in their family to attend college. For example, about one-third of students at risk had parents who completed no more than a high school education, compared with one in twelve of students not at risk.[24] Thus, for a substantial proportion of at-risk students, there may be no one in their family who has had firsthand experience in applying to college. These students are more dependent on schools and teachers for obtaining information and getting help with the application process. To determine if there were differences in the way at-risk students with different postsecondary enrollment outcomes prepared for applying to college, comparisons were made in the rates at which students in different outcome groups reported taking a special course offered by the school to prepare for entrance exams, and receiving help from their school or teachers in filling out college applications. Both preparation steps were reported by the students in 1992, when most were in the twelfth grade.

Engagement Activities

How engaged students are in their high school life and how involved their parents are in promoting learning activities are strong indicators of students' likelihood of graduating from high school.[25] In Chen and Kaufman's study, several indicators measuring student engagement, parent involvement, and peer association were found to increase students' odds of graduating from high school.[26] In this study, these indicators (described below) were used to compare the levels of engagement reported by at-risk youth with different postsecondary enrollment outcomes.

Student Engagement

Student engagement was analyzed in two ways: first, by determining the level of high school attendance reported by students, and second, by identifying the number of extracurricular activities in which students had participated. The level of attendance is a composite variable

[23]In determining the extent of math course taking, the sample was limited to students who had all four years of their transcripts available (about 65 percent) (NELS:88/94 Data Analysis System).

[24]See table 4.

[25]X. Chen and P. Kaufman, "Risk and Resilience"; and L. J. Horn and J. West, *A Profile of Parents of Eighth Graders* (NCES 92-488) (Washington D.C.: U.S. Department of Education, National Center for Education Statistics, 1992).

[26]Ibid.

based on several items asking students to report on how many times they had been late for school, skipped school, or been absent. The extent of their participation in extracurricular activities was an item that directly asked students about their activities in various areas such as student government, band, service clubs, and so on. Both sets of questions were asked in 1990.

Parent Engagement

Parent engagement is based on parents' responses to questions asking how involved they were in their teens' schooling (asked in 1992) and what their expectations were for their teens' future education (asked in 1990). The involvement indicator is a composite based on several items asking parents to report on the frequency with which they discussed the following with their child: the selection of high school courses, school activities of particular interest to their child, things their child has studied in class, plans for taking entrance exams, and applying to college after high school.

Peer Engagement

Two measures of peer engagement were used to determine the extent to which students' friends were involved in school. First, students reported on the importance that their friends attributed to various learning activities (asked in 1990), and second, they reported on the number of their friends who planned to attend a four-year college (asked in 1992). The learning activities indicator was based on several items that asked students how important their friends thought the following activities were: attending classes, studying, getting good grades, finishing high school, and continuing their education after high school graduation.

OVERVIEW OF STUDENTS AT RISK

DISTRIBUTION OF RISK FACTORS

Among all 1992 high school graduates, more than half (58 percent) had at least one risk factor that increased their chances of dropping out of high school (table 1). Approximately one-third (32 percent) had one risk factor, 16 percent had two, and 9 percent had three or more.

Table 1—Risk status of 1992 high school graduates: total percentage with any risk factors, with each risk factor, the percentage distribution by number of risk factors, and the average number of risk factors among all high school graduates

		Percentage distribution			Average
	Percentage at risk	One risk factor	Two risk factors	Three or more	number of risk factors
Total	57.8	32.2	16.3	9.3	1.7
Individual Risk Factors	Percent with each risk factor				
Changed schools two or more times from 1st to 8th grade (other than natural progression)	26.8	46.8	29.9	23.3	1.9
Lowest SES quartile*	18.2	31.1	34.1	34.7	2.2
Average grades C's or lower from 6th to 8th grade	16.7	31.2	36.3	32.5	2.2
Single parent family	15.3	32.7	34.1	33.3	2.2
Older sibling(s) dropped out of high school	11.2	22.6	35.5	41.9	2.4
Held back one or more grades from 1st to 8th grade	11.2	19.9	38.7	41.4	2.4

*SES quartiles were determined for all 1988 eighth graders. The group represented in this table are 1992 high school graduates, who are less likely to be in the lowest SES quartile, which is why the proportion is 18 percent instead of 25 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

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Changing schools two or more times was the most common risk factor: 27 percent of 1992 high school graduates had done so by the eighth grade. For the remaining risk factors, 18 percent of high school graduates were from families in the lowest SES quartile;[27] 17 percent had grades of C's or lower from sixth to eighth grade; 15 percent were from single parent families; 11 percent had older siblings who had dropped out of high school; and 11 percent were held back a grade.

Among all 1992 high school graduates, the average number of risk factors was about 1.7. Students who were held back or who had siblings who dropped out of high school tended to have more risk factors on average (2.4) than those with other risk factors (1.9 to 2.2).

When high school graduates had only one risk factor, it was most likely changing schools two or more times: 39 percent of those with one risk factor had done so (table 2). Relatively fewer (15 to 17 percent) were from low-SES families, had grades of C's or lower, or lived in single parent families. About 7 and 8 percent, respectively, of students with one risk factor were held back a grade or had an older sibling who had dropped out of school.

DEMOGRAPHIC COMPOSITION

Students at risk were more likely to be Hispanic or black, non-Hispanic (12 percent and 14 percent, respectively) than students not at risk (5 percent each were either Hispanic or black) (table 3). Moreover, the proportion of black students among those at high risk (three or more risk factors) was much higher than the proportion among lower risk students (one risk factor) (22 versus 10 percent). The same was not true of Hispanic students, however; their representation did not change appreciably among the three risk groups (11 to 14 percent). The proportion of Asian/Pacific Islander students and American Indian/Alaskan Native students was also similar at all three levels of risk.

One reason for the relatively high proportion of black students among high-risk students relative to their Hispanic peers was their likelihood of being from a single parent family. One-quarter of students from single parent homes were black, compared with 9 percent of their counterparts who were Hispanic.

Having parents who completed no more than a high school education was far more common among students at risk (35 percent) than it was for those not at risk (12 percent) (table 4).

[27]The SES quartiles were calculated for the entire eighth-grade cohort. High school graduates were less likely to fall into the lowest quartile, which is why the proportion is less than 25 percent.

Furthermore, as the number of risk factors increased, so did the proportion of students whose parents had no more than a high school education.

Table 2—Percentage of 1992 high school graduates with each risk factor, by number of risk factors and all other risk factors

	Changed schools two or more times from 1st to 8th grade	Lowest SES quartile	Average grades C's or lower from 6th to 8th grade	Single parent family	Older sibling(s) dropped out of high school	Held back one or more grades from 1st to 8th grade
Total	26.8	18.2	16.7	15.3	11.2	11.2
Number of risk factors						
Any risk factors	46.2	30.6	28.7	26.1	19.2	19.5
One risk factor	38.7	17.1	16.1	15.3	7.8	6.9
Two risk factors	49.6	37.1	37.0	31.7	24.4	26.9
Three or more	66.4	66.0	57.9	54.0	48.7	51.2
Number of school changes from 1st to 8th grade						
Two or more times	100.0	18.8	20.3	19.2	14.6	16.6
Less than two	0.0	16.9	15.0	13.6	9.4	8.7
SES in 1988						
Lowest quartile	29.0	100.0	26.1	25.0	24.4	20.3
Middle to high quartiles	26.3	0.0	14.7	13.1	8.1	9.3
Average grades from 6th to 8th grade						
C's or lower	33.0	28.1	100.0	21.1	16.6	23.2
A's or B's	25.5	16.0	0.0	14.1	9.8	8.8
Family composition in 1988						
Single parent family	34.0	29.7	23.2	100.0	17.4	17.4
Other than single parent	25.5	16.1	15.6	0.0	9.8	10.1
Older siblings who left high school						
One or more	35.0	38.8	24.7	23.8	100.0	20.8
None left or no siblings	24.6	14.8	15.2	13.9	0.0	9.6
Ever held back 1st to 8th grade						
Held back at least once	40.8	31.3	33.1	23.1	20.4	100.0
Not held back	24.9	15.5	13.7	13.8	9.5	0.0

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

Table 3—Percentage distribution of 1992 high school graduates according to race–ethnicity, by number of risk factors and individual risk factors

	Race–ethnicity				
	Asian/ Pacific Islander*	Hispanic*	Black, non-Hispanic	White, non-Hispanic	American Indian/ Alaskan Native*
Total	4.6	9.5	10.9	74.1	1.0
Risk status					
No risk factors	3.7	4.8	5.4	85.4	0.7
Any risk factors	3.9	11.6	13.5	70.1	1.0
One risk factor	4.4	10.8	9.8	74.3	0.7
Two risk factors	3.3	11.9	16.0	67.6	1.3
Three or more	3.1	13.7	21.9	60.2	1.2
Individual Risk Factors					
SES in 1988					
Lowest quartile	3.2	21.7	20.1	53.7	1.3
Middle to high quartiles	4.1	6.2	8.1	80.8	0.8
Family composition in 1988					
single parent family	1.7	8.6	24.1	64.5	1.1
Other than single parent	4.3	9.0	7.9	78.1	0.9
Number of older siblings who left high school					
One or more	4.0	13.0	14.3	67.5	1.3
None left or no siblings	4.0	7.8	9.3	78.1	0.8
Number of school changes from 1st to 8th grade					
Two or more times	5.6	10.2	12.2	71.1	0.9
Less than two	3.2	7.6	9.2	79.3	0.7
Average grades from 6th to 8th grade					
C's or lower	3.1	10.8	11.9	72.9	1.3
A's or B's	4.0	8.5	10.0	76.7	0.8
Ever held back 1st to 8th grade					
Held back at least once	3.2	11.0	15.7	68.7	1.4
Not held back	4.0	8.5	8.6	78.2	0.8

*Some of the row percentages do not include the total percentage within their range (e.g., 3.7 and 3.9 percent of Asian/ Pacific Islanders with no risk factors and any factors respectively, does not include the total of 4.6 percent) because there is a greater proportion missing for the row variables than for the total.

NOTE: Details may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

Table 4—Percentage distribution of 1992 high school graduates according to parents' highest educational attainment, by number of risk factors and individual risk factors

	Parents' highest education*		
	High school or less	Some postsecondary education	Bachelor's degree or higher
Total	26.5	41.0	32.5
Risk factors			
No risk factors	11.8	41.9	46.4
Any risk factors	34.9	41.4	23.6
One risk factor	24.9	43.0	32.1
Two risk factors	42.6	41.0	16.4
Three or more	57.5	36.3	6.2
Individual Risk Factors			
SES in 1988			
Lowest quartile	76.1	23.6	0.3
Middle to high quartiles	13.7	45.7	40.7
Family composition in 1988			
Single parent family	37.3	43.3	19.4
Other than single parent	23.1	41.2	35.7
Number of older siblings who left high school			
One or more	42.9	43.6	13.5
None left or no siblings	23.7	40.3	36.0
Number of school changes from 1st to 8th grade			
Two or more times	23.1	42.8	34.1
Less than two	24.9	41.5	33.6
Average grades from 6th to 8th grade			
C's or lower	37.8	46.0	16.2
A's or B's	22.7	40.7	36.6
Ever held back 1st to 8th grade			
Held back at least once	36.8	44.5	18.8
Not held back	23.0	41.4	35.6

*Some of the row percentages do not include the total percentage within their range because there is a greater proportion of missing cases for the row variables than for the total.

NOTE: Details for percentage distribution may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

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POSTSECONDARY ENROLLMENT

By 1994, nearly two-thirds (64 percent) of students with no risk factors had enrolled in a four-year college, compared with about one-third (35 percent) of at-risk students (table 5). Students at risk enrolled in public two-year institutions at slightly higher rates than did their counterparts not at risk (27 percent versus 22 percent); however, they were much more likely *not* to enroll in any postsecondary education by 1994 (32 percent versus 12 percent) than students not at risk.

The postsecondary enrollment outcomes of students with each individual risk factor compared with those without the risk factor is also shown in table 5. For all six risk indicators, students with the risk factor were less likely to enroll in a four-year college and more likely *not* to enroll in postsecondary education.[28]

While these outcomes are consistent with earlier studies, the specific question for this analysis concerns students who had both college aspirations and were at least minimally prepared academically to attend. Specifically, if students at risk entered the four-year college pipeline and made the necessary preparations to go to college, were they still less likely than those not at risk to enroll in a four-year college?

[28]It is also true that students with each risk factor generally have more than one risk factor (see table 1). However, a linear regression model also found a significant negative effect on enrolling in a four-year college for each risk factor independent of all others (see appendix table C1). On the other hand, when the outcome was expanded to include enrollment in *any* postsecondary education (4-year, 2-year, or less-than-2-year institutions), the effect of living in a single parent home on the likelihood of enrolling was actually positive (appendix table C2). Changing schools two or more times had no effect and all others had a significantly negative effect on enrollment in any postsecondary education.

Table 5—Percentage distribution of 1992 high school graduates according to the first postsecondary institution attended, by number of risk factors and individual risk factors

	Type of institution first enrolled			
	4-year institution	Public 2-year institution*	Other less-than-4-year institution	Never enrolled
Total	45.1	25.7	4.4	24.8
Risk factors				
No risk factors	63.5	21.9	2.4	12.2
Any risk factors	35.0	27.3	5.7	32.0
One risk factor	45.1	26.0	5.2	23.8
Two risk factors	27.0	28.4	5.9	38.7
Three or more	14.0	29.7	7.1	49.2
Individual Risk Factors				
SES in 1988				
Lowest quartile	21.7	25.2	6.3	46.8
Middle to high quartiles	52.1	25.2	3.9	18.8
Family composition in 1988				
Single parent family	38.6	28.1	4.7	28.7
Other than single parent	48.3	24.5	4.3	22.9
Number of older siblings who left high school				
One or more	25.7	28.7	5.5	40.1
None left or no siblings	49.8	24.8	4.2	21.2
Number of school changes from 1st to 8th grade				
Two or more times	39.8	28.0	6.1	26.1
Less than two	50.0	24.1	3.6	22.3
Average grades from 6th to 8th grade				
C's or lower	16.3	29.8	7.7	46.2
A's or B's	52.8	24.2	3.7	19.3
Ever held back 1st to 8th grade				
Held back at least once	20.6	30.0	5.3	44.2
Not held back	51.2	24.4	4.1	20.3

*Some of the row percentages do not include the total percentage within their range because there is a greater proportion of missing cases for the row variables than for the total.

NOTE: Details for percentage distribution may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

PIPELINE TO A FOUR-YEAR COLLEGE

The pipeline to college consists of five sequential steps leading to college enrollment. There is an implicit assumption that each step in the pipeline is essential for college enrollment. However, the analysis showed that there was an exception to this assumption. Five percent of high school graduates who enrolled in a four-year college did not have a bachelor's degree goal in the tenth grade, but completed the remaining four pipeline steps to enrollment.[29] Presumably, these students changed their minds about pursuing a college education after they had reported their tenth-grade aspirations. However, there was no difference in risk status among students who followed this pattern: at-risk students were just as likely as those not at risk to do so. Virtually all other students who enrolled in a four-year college completed all five steps of the pipeline.[30] Figure 1 and table 6 illustrate these students' sequential progress through the pipeline to college.

The proportion of students at each step is based on those who successfully completed all the preceding steps. For example, the proportion in step 2 are students who had both a bachelor's degree goal in the tenth grade (step 1) and were at least minimally prepared academically to attend a four-year college (step 2); those in step 3 are students who had a bachelor's degree goal (step 1), were minimally prepared (step 2), and took college entrance exams (step 3); and so on.

The first two steps of the pipeline are clearly the junctures where most at-risk students leave the pipeline relative to students not at risk. About 56 percent of at-risk students entered the pipeline by aspiring to a bachelor's degree in the tenth grade, compared with 81 percent of those not at risk. Similarly, the proportion of at-risk students who progressed from having a bachelor's degree goal to being at least minimally prepared academically to attend a four-year college (44 percent) was much lower than the proportion of students not at risk (75 percent).

One might expect at-risk students who had a bachelor's degree goal and who had performed well enough in school to at least minimally prepare themselves academically to enroll in a four-year college, to progress through the rest of the pipeline at similar rates as students not at risk. However, this was not the case (figure 2). While the proportions who were lost in steps 3 to 5 were relatively small compared with those lost in step 1, at-risk students were much less likely

[29]NELS:88/94 Data Analysis System.

[30]There were a few instances where students who enrolled in a four-year college did not report taking entrance exams (0.5 percent); they were recoded as having done so (NELS:88/94 Data Analysis System).

than those who were not at risk to take step 3 (entrance exams) (9 percent did not take exams versus 3 percent); and if they took entrance exams, they were less likely to apply to college than those not at risk (13 percent did not apply versus 9 percent).

Table 6—Percentage of 1992 high school graduates who progressed through each step in the pipeline to enrollment in a 4-year institution by 1994,[1] by risk status[2]

	Step 1	Step 2	Step 3	Step 4	Step 5
	10th-grade bachelor's degree aspirations	At least minimally prepared academically[3]	Took SAT and/or ACT	Applied to 4-year institution	Enrolled in 4-year institution by 1994[4]
Total	65.8	55.5	52.4	46.7	40.3
Risk Status[2]					
No risk factors	80.8	74.7	72.6	65.9	58.1
Any risk factors	55.7	44.2	40.3	35.0	29.5
One risk factor	63.9	54.5	51.1	44.8	39.3
Two risk factors	48.9	35.7	30.9	26.0	21.2
Three or more	38.8	23.0	18.8	16.2	9.7

[1]To be included in the second through fifth columns, students must have been included in all previous columns.

[2]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

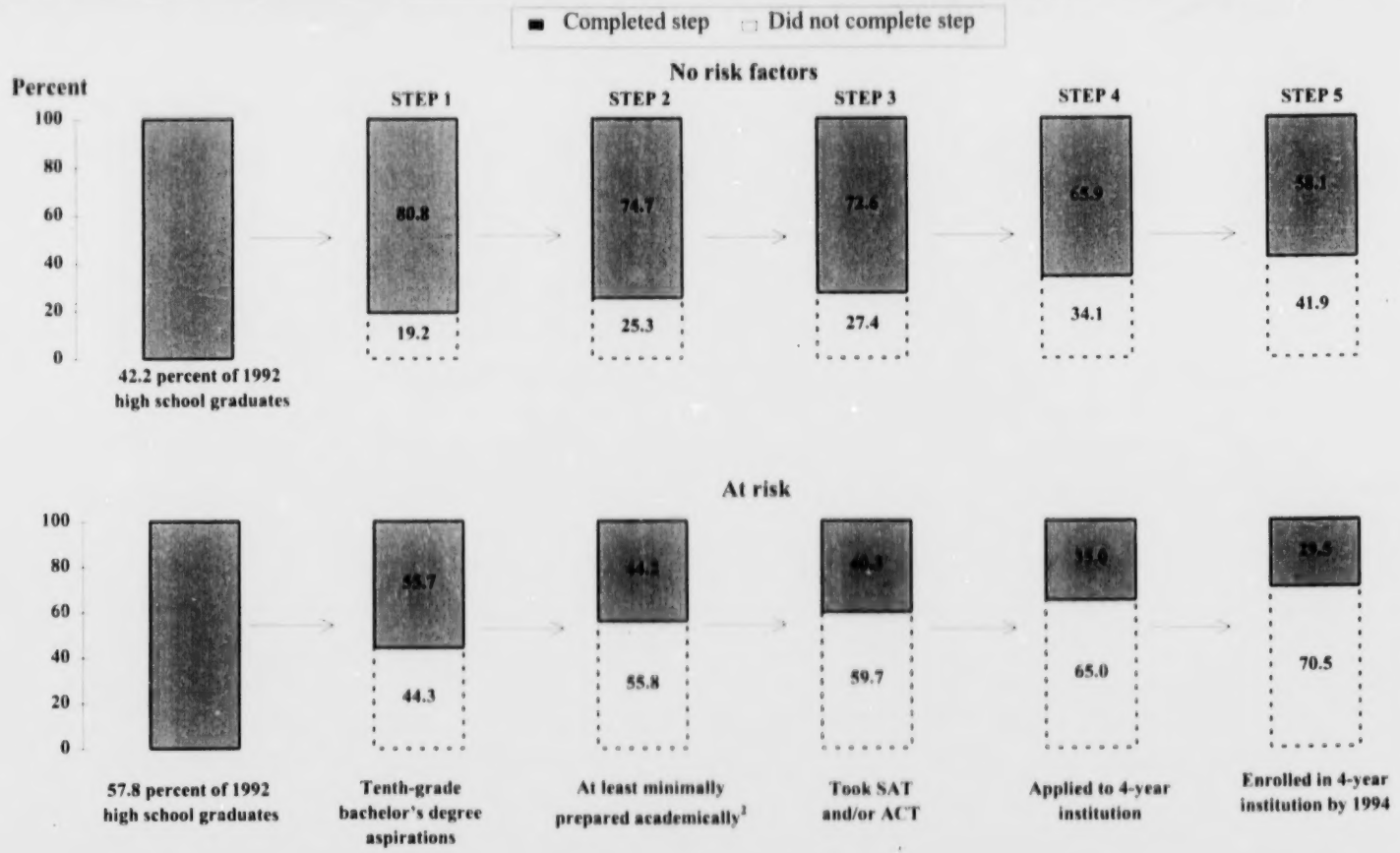
[3]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

[4]Percentages differ from table 5 because the students who did not have a bachelor's degree goal in the 10th grade (i.e., did not complete step 1) are not included (5 percent).

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

With respect to completing the pipeline, the proportion of at-risk students and those not at risk who completed all previous steps but did not enroll in a four-year college also differed (16 percent versus 12 percent). However, this may be attributed to the difference in college acceptance rates: 92 percent of at-risk students who completed the four steps of the pipeline leading up

Figure 1—Percentage of 1992 high school graduates who followed the steps of the pipeline to 4-year college enrollment, by risk status[1]



[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

NOTE: Details may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

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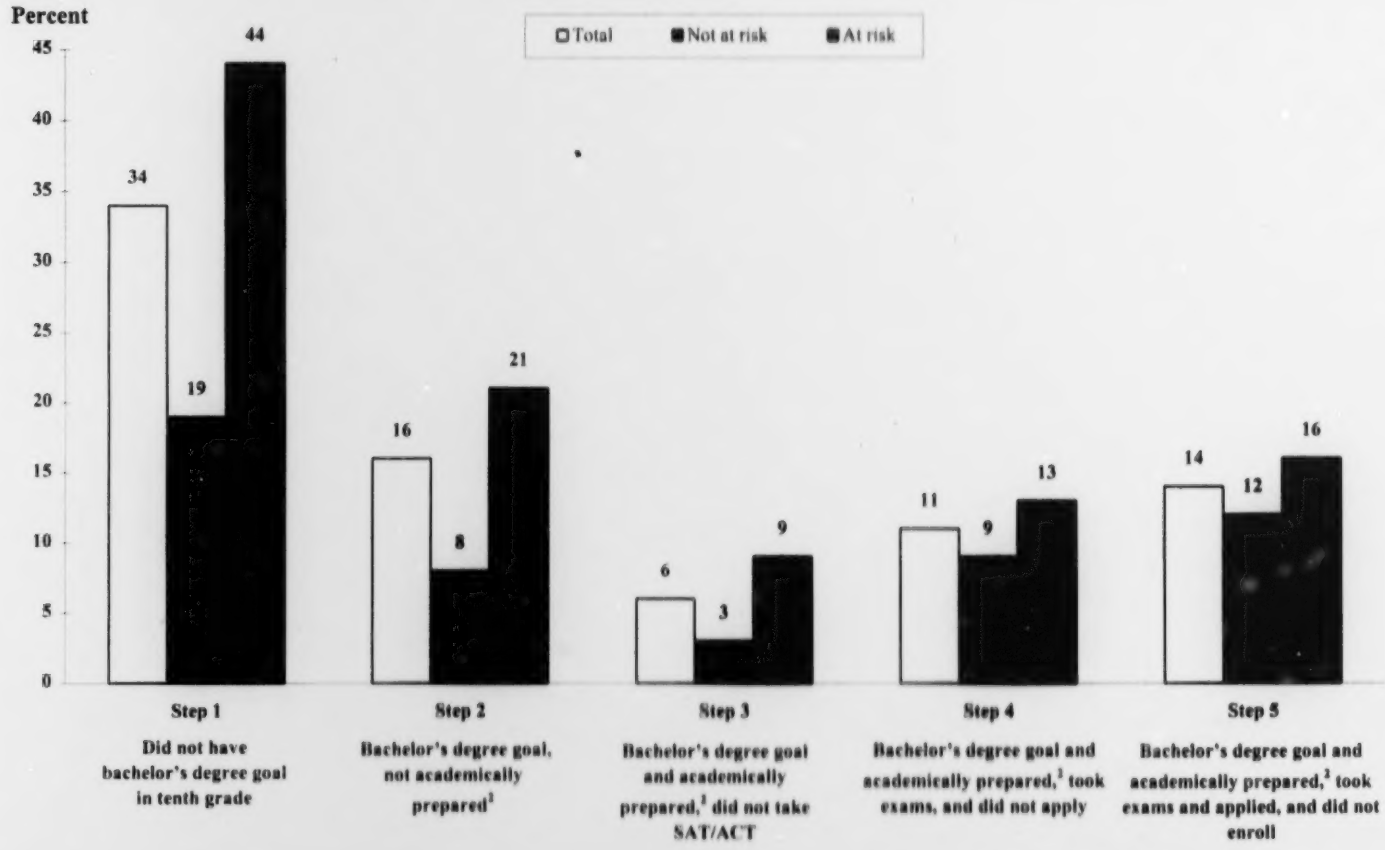
Figure 2—Among 1992 high school graduates who progressed through the college pipeline, the percent lost at each step among those remaining from the previous step, by risk status[1]



[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

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to enrollment were accepted by at least one institution, compared with 97 percent of those not at risk.[31]

OUTCOMES OF STUDENTS NOT ADVANCING THROUGH THE PIPELINE

Among 1992 high school graduates who took no pipeline steps (i.e., they never aspired to a bachelor's degree and took no other pipeline steps), students at risk had outcomes similar to those not at risk (table 7). As of 1994, 21 and 23 percent, respectively, enrolled in a public two-year college; 8 percent and 9 percent, respectively, enrolled in other less-than-four-year institutions, and 71 percent and 68 percent, respectively, had not enrolled in postsecondary education.

On the other hand, among students who took any steps in the pipeline,[32] those at risk were less likely than those not at risk to enroll in public two-year colleges (50 percent versus 65 percent) and were no more likely to enroll in other postsecondary education (table 7). Even when controlling for academic preparation, a difference was found between at-risk students and those not at risk in the proportion enrolled in public two-year colleges: 46 percent compared with 57 percent enrolled among academically prepared students and 52 percent compared with 68 percent enrolled among those not academically prepared.

POSTSECONDARY PERSISTENCE INDICATORS

The analysis thus far has examined the postsecondary enrollment patterns of 1992 high school graduates. However, enrollment does not necessarily guarantee that students will persist to degree attainment. Therefore, it is useful to examine indicators of postsecondary persistence to determine if students at risk differ from their counterparts not at risk in this respect. To this end, students were identified according to postsecondary enrollment patterns that have been shown to reduce students' chances of completing a degree. These indicators include delaying postsecondary education by a year or more after high school graduation, beginning postsecondary education on a part-time basis, or not attending continuously from the time of enrollment (i.e.,

[31]Note that once students were accepted, those at risk were as likely to enroll as those not at risk (about 91 percent). Estimates taken from the NELS:88/94 Data Analysis System.

[32]This includes students who took any of the four steps in the pipeline regardless of the sequence. Appendix table C3 shows the percentage of students for all the different combinations of steps taken among those who did not enroll in a four-year college.

stopping for four or more months).[33] Students who exhibited none of these enrollment behaviors (i.e., they enrolled full time within a year of high school graduation and attended continuously) were identified as having strong persistence indicators.

Table 7—Percentage distribution of 1992 high school graduates who did not enroll in a 4-year college by 1994 according to their postsecondary education enrollment, by pipeline status, risk status, and academic preparation[1]

	Enrolled in public 2-year institution	Enrolled in other less-than-4-year institution	Never enrolled
Total	46.9	8.0	45.2
College pipeline status			
		No risk factors[2]	
Took no pipeline steps	22.9	9.4	67.7
Took any steps	65.4	6.6	28.1
Not academically prepared	67.9	6.2	25.8
Academically prepared	56.6	7.6	35.8
		One or more risk factors[2]	
Took no pipeline steps	21.3	8.0	70.7
Took any steps	50.3	8.9	40.8
Not academically prepared	51.8	8.2	39.9
Academically prepared	45.8	10.8	43.4

[1]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

[2]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

NOTE: Details may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

[33]See, for example, L. Berkner, S. Cuccaro-Alamin, and A. McCormick, *Descriptive Summary of 1989–90 Beginning Postsecondary Students: 5 Years Later* (NCES 96-155) (Washington D.C.: U.S. Department of Education, National Center for Education Statistics, 1996); or L. Horn, *Nontraditional Undergraduates: Trends in Enrollment from 1986 to 1992 and Persistence and Attainment Among 1989–90 Beginning Postsecondary Students* (NCES 96-578) (Washington D.C.: U.S. Department of Education, National Center for Education Statistics, 1996).

The results indicate that at-risk students were less likely to exhibit strong persistence indicators than students not at risk. This was true for students enrolled in either a four-year college or a public two-year institution (table 8): 72 percent of at-risk students who enrolled in a four-year college by 1994 exhibited strong persistence indicators, compared with 81 percent of students not at risk; 34 percent of at-risk students who enrolled in a public two-year college exhibited strong persistence indicators, compared with 48 percent of students not at risk. Similar differences were not found, however, for students who enrolled in other forms of postsecondary education (39 percent and 43 percent, respectively).

Table 8—Among 1992 high school graduates who enrolled in postsecondary education by 1994, the percentage who had strong persistence indicators,[1] by risk status[2] and type of first institution

	Percent with strong persistence indicators	
	No risk factors	One or more risk factors
Total	71.0	53.0
Type of first postsecondary institution		
4-year	81.2	72.0
Public 2-year	47.5	34.0
Other less-than-4-year	42.5	38.8

[1]Enrolled full time within one year of high school graduation and attended continuously from time of enrollment.

[2]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

COMPARISONS AMONG AT-RISK STUDENTS

The results of the pipeline analysis indicate that at-risk students who graduate from high school, despite having characteristics associated with dropping out, remain at risk with respect to gaining access to higher education relative to their counterparts not at risk. Furthermore, once enrolled, students at risk are less likely to exhibit strong persistence indicators. Nevertheless, about one-third of 1992 high school graduates at risk succeeded in preparing for and enrolling in a four-year college. How do these at-risk students differ from their peers who did not enroll in any postsecondary education or who enrolled in less-than-four-year institutions? The remainder of this report will address this question.

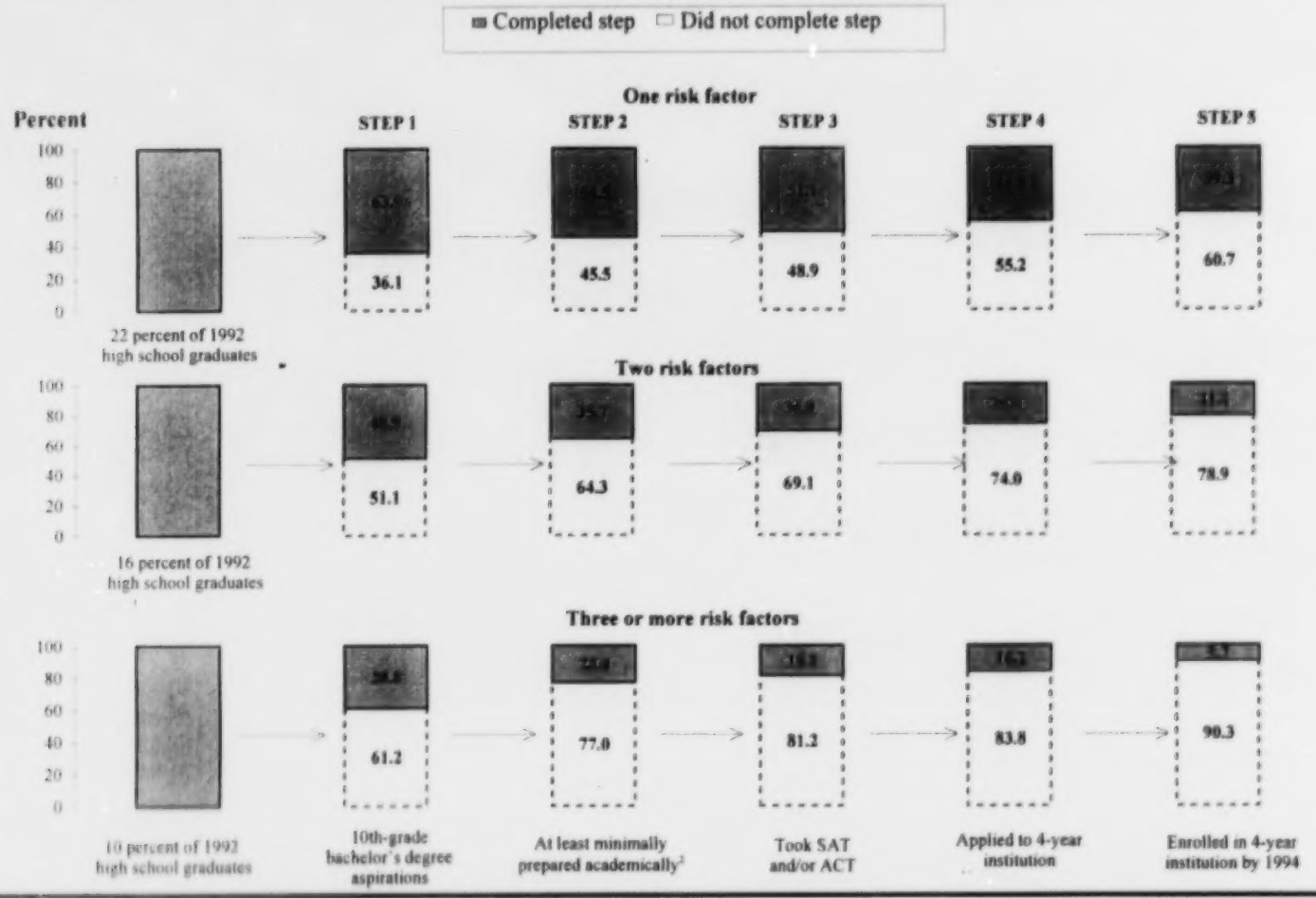
Number of Risk Factors

The level of risk experienced by high school graduates was strongly linked to their chances of progressing through the pipeline to college. As shown in figure 3, students with only one risk factor were much more likely to progress through the college pipeline than those with two risk factors (39 versus 21 percent). Likewise, those with two risk factors (21 percent) were more likely than students with three or more risk factors (10 percent) to do the same.

Large differences between students at lower risk and those at high risk appeared at steps 1 and 2 of the pipeline: educational aspirations and academic preparation. For example, about two-thirds (64 percent) of students at relatively low risk (one risk factor) had a bachelor's degree goal in tenth grade, compared with just over a third (39 percent) of students at high risk (three or more risk factors).

In order to minimize the differences associated with level of risk, the remainder of this analysis focuses only on at-risk students who completed steps 1 and 2 of the pipeline. Thus, comparisons are limited to at-risk students who had aspired to earn a bachelor's degree *and* were at least minimally prepared academically to enroll in a four-year college. Just under half (44 percent) of at-risk students progressed this far in the pipeline (figure 1). Their postsecondary enrollment outcomes are shown in figure 4. As of 1994, about two-thirds (68 percent) had enrolled in a four-year college; one in five (19 percent) had enrolled in a public two-year institution;

Figure 3—Percentage of 1992 high school graduates who followed the steps of the pipeline to 4-year college enrollment, by risk status[1]



[1]Risk factors include: low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

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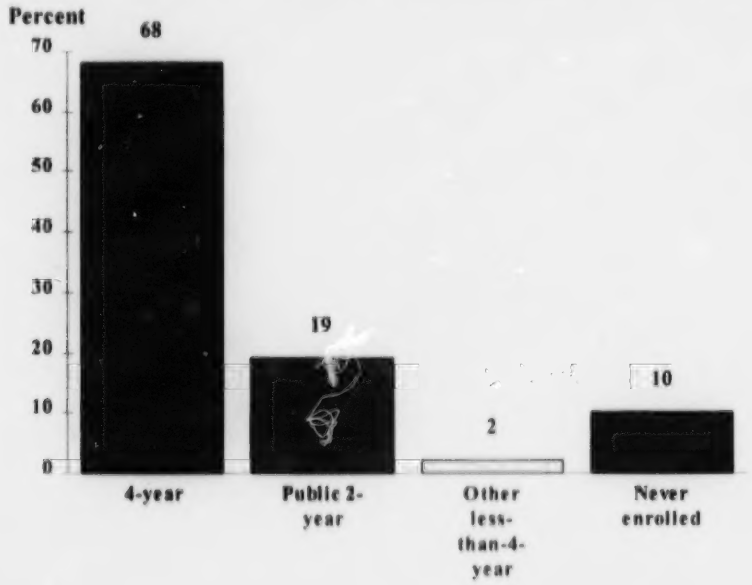
Figure 4—Among 1992 high school graduates with any risk factors[1] who had a bachelor's degree goal in the 10th grade and were at least minimally prepared academically[2] to attend a 4-year college, percentage distribution according to postsecondary enrollment by 1994



[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

NOTE: Details may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

2 percent were in other less-than-four-year institutions; and one in ten had not enrolled in any postsecondary education.

Because of the small proportion of students enrolled in other less-than-four-year institutions, this group is combined with students enrolled in public two-year institutions for the remainder of the analysis. Three outcome groups are compared: those enrolled in a four-year college, those enrolled in other postsecondary education, and those who did not enroll. These students are compared according to their level of high school math course taking, whether they

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received help from their school in the college application process, and according to the level of engagement exhibited by students, their parents, and their peers.

MATH COURSE TAKING

A majority of at-risk students who aspired to a bachelor's degree and were at least minimally prepared academically to enroll in a four-year college had completed the "gatekeeping" sequence of high school math courses: 32 percent had completed courses through algebra II and another 54 percent had completed at least one advanced math class (table 9).

There were clear differences, however, between students who enrolled in a four-year college and those who enrolled in other postsecondary education or who did not enroll with respect to the level of math courses completed. For example, about two-thirds (64 percent) of those who enrolled in a four-year college completed at least one advanced math course, compared with about one-third who enrolled in other postsecondary education or who did not enroll at all (36 and 31 percent, respectively). There were no measurable differences in the proportion of students taking advanced math courses, on the other hand, between those enrolled in less-than-four-year institutions and those who did not enroll.

RECEIVED HELP FROM THE SCHOOL WITH THE POSTSECONDARY APPLICATION PROCESS

Since at-risk students are much more likely to be the first in their family to go to college than students not at risk, the school is an important source of information and assistance in making the transition to college. Roughly half (52 percent) of the at-risk students who had a bachelor's degree goal and were at least minimally prepared academically to enroll in a four-year college reported receiving help from their school with filling out their postsecondary application (for all postsecondary institutions) (table 10). However, those who enrolled in a four-year college were more likely to report receiving such help (56 percent) than either those who enrolled in less-than-four-year institutions (44 percent) or those who had never enrolled (43 percent).

Students with different postsecondary outcomes did not differ substantially, however, with regard to taking a special course offered by the school to help them prepare for the college entrance exams: 21 percent of students enrolled in a four-year college, 16 percent of those enrolled in other postsecondary education, and 18 percent who did not enroll reported taking such a course.

Table 9—Among 1992 high school graduates with one or more risk factors[1] who had a bachelor's degree goal in the 10th grade and were at least minimally prepared academically to enroll in a 4-year college,[2] the percentage distribution according to the highest level of math courses completed in high school, by type of first postsecondary institution

	No math/ non academic or low academic courses	Algebra I and geometry	Algebra II	Calculus and/or other advanced classes
Total	1.6	12.6	32.3	53.5
Type of first postsecondary institution				
4-year	1.5	7.5	26.5	64.4
Less-than-4-year	0.2	19.3	44.3	36.2
Not enrolled	4.5	26.2	38.2	31.2

[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

NOTE: Details may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

STUDENT, PARENT, AND PEER ENGAGEMENT

The following analysis attempts to discern the relationship between different postsecondary enrollment outcomes and engagement indicators that are strong predictors of high school graduation.[34] Specifically, it addresses whether engagement indicators associated with successfully completing high school facilitate the transition from high school to college enrollment among at-risk high school graduates who aspired to a bachelor's degree goal and who were at least minimally prepared to enroll in a four-year college.

[34]Chen and Kaufman, "Risk and Resilience."

Table 10—Among 1992 high school graduates with one or more risk factors[1] who had a bachelor's degree goal in the 10th grade and were at least minimally prepared academically to enroll in a 4-year college,[2] the percentage who reported receiving help from their school in preparing postsecondary education applications, by type of first postsecondary institution

	Student received help from school in application process	
	Received help filling out application	Took special class to prepare for entrance exam
Total	51.8	19.8
Type of first postsecondary institution		
4-year	56.2	21.2
Less-than-4-year	44.2	16.1
Not enrolled	42.9	18.0

[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

Student Engagement

Patterns of school attendance reported by the student, including absenteeism, cutting classes, and being late for school, formed the basis for the first student engagement indicator. Participating in two or more extracurricular activities was the second indicator.

Among at-risk students who aspired to a bachelor's degree and were academically prepared for college enrollment, where they eventually enrolled (or if they enrolled) did not appear to be associated with the high school attendance indicator (table 11). For example, 28 percent of those enrolled in four-year colleges were in the highest attendance group as were 23 percent of those who had not enrolled.[35]

[35]There appear to be differences among the enrollment groups for low and moderate attendance, but there is not enough statistical evidence to conclude that they are different.

Table 11—Among 1992 high school graduates with one or more risk factors[1] who had a bachelor's degree goal in the 10th grade and were at least minimally prepared academically to enroll in a 4-year college,[2] the percentage distribution according to level of class attendance in high school and the percentage reporting two or more extracurricular activities, by type of first postsecondary institution

	Class attendance (1990)			Two or more extracurricular activities
	Low attendance	Moderate attendance	High attendance	
Total	15.5	58.6	25.9	44.7
Type of first postsecondary institution				
4-year	14.5	57.9	27.6	47.9
Less-than-4-year	20.3	57.7	22.1	40.9
Not enrolled	11.6	65.6	22.9	34.4

[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

NOTE: Details for percentage distribution (class attendance) may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

The rate at which students participated in two or more extracurricular activities, on the other hand, did distinguish students who enrolled in a four-year college (48 percent) from those who had never enrolled in postsecondary education (34 percent). However, with respect to this indicator, four-year college enrollees did not differ significantly from their counterparts enrolled in other postsecondary education (41 percent).

Parents' Educational Expectations and Level of Engagement

Parents' educational expectations and the frequency with which they reported having school-related discussions with their teen were engagement variables that were used to assess parent involvement. For at-risk students who had progressed as far as having a bachelor's degree goal and who were at least minimally prepared academically for a four-year college, nearly all (91 percent) of their parents expected them to complete a bachelor's degree. For these students,

where (or if) they enrolled was not significantly associated with their parents' educational expectations (table 12).

Table 12—Among 1992 high school graduates with one or more risk factors[1] who had a bachelor's degree goal in the 10th grade and were at least minimally prepared academically to enroll in a 4-year college,[2] the percentage distribution according to parents' educational expectations and the frequency of school-related discussions, by type of first postsecondary institution

	Parents' educational expectations for child, 1990			Parents discuss school-related matters with child, 1992		
	High school or less	Vocational/ some college	Bachelor's or higher	Little to no discussion	Some discussion	Much discussion
Total	0.9	8.4	90.7	15.7	46.6	37.8
Type of first postsecondary institution						
4-year	0.6	7.1	92.3	13.1	46.6	40.4
Less-than-4-year	1.1	10.9	88.0	20.4	44.8	34.8
Not enrolled	1.7	12.3	86.0	24.3	50.2	25.6

[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

NOTE: Details for each percentage distribution may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

On the other hand, the frequency with which parents reported discussing school-related matters with their child did distinguish students who enrolled in a four-year college from those who either enrolled in other postsecondary education or who did not enroll. For example, four-year college enrollees were less likely to have parents who had little to no discussion with them (13 percent) than were students who enrolled in other postsecondary education (20 percent) or those who had never enrolled (24 percent). At the other end of the spectrum, the proportion of parents reporting a high level of discussion (shown as "much discussion" in the table) did not differ between students enrolled in a four-year college and those enrolled in other postsecondary education (40 percent and 35 percent, respectively). However, parents of four-year college enrol-

lees were more likely to report much discussion than students who had never enrolled (26 percent).

Peer Engagement

The final set of engagement indicators concerns the extent to which students' friends were involved in school activities. Both peer engagement indicators are based on items reported by the students about their friends. The first indicates how important students thought their friends considered the following learning activities: attending classes, studying, getting good grades, finishing high school, and continuing education past high school. The second was the number of students' friends with plans to attend a four-year college.

Among at-risk students who aspired to a bachelor's degree and were at least minimally prepared to enroll in a four-year college, there was no difference in the level of importance that friends attributed to learning activities relative to postsecondary enrollment outcomes. Roughly one-third of students reported that their friends considered these activities very important regardless of their enrollment status (table 13).

The number of students' friends with plans to attend a four-year college, on the other hand, was strongly associated with enrollment outcomes. Students who enrolled in a four-year college were much more likely to report that all or most of their friends planned to attend (80 percent), compared with those who enrolled in other postsecondary education (60 percent) or those who never enrolled (49 percent).

CONTROLLING FOR RELATED VARIABLES

In analyzing how certain variables are associated with at-risk students' likelihood of enrolling in postsecondary education, the study thus far has examined each variable separately. However, some of the variables may be related to one another and also to other background characteristics. For example, more highly educated parents may report discussing school-related matters with their teen more often than parents with less education. Conversely, students who have college-educated parents may not seek help from their school in applying to college as often as students whose parents have not been to college. Therefore, linear regression models were used to determine the individual influence of each variable examined in the tabular analysis, on the likelihood of postsecondary enrollment (see appendix B for details about methods used). The analysis is based only on at-risk students, and two different outcomes were considered: enrolling

Table 13—Among 1992 high school graduates with one or more risk factors[1] who had a bachelor's degree goal in the 10th grade and were at least minimally prepared academically to enroll in a 4-year college,[2] the percentage distributions according to level of importance peers attribute to learning activities, and the number of friends with college plans, by type of first postsecondary institution

	Friends think learning is important (1990)			Number of friends who plan to attend a 4-year college		
	Not very important	Moderately important	Highly important	No friends plan college	Few to some friends	Most friends
Total	15.0	54.5	30.5	2.2	25.5	72.3
Type of first postsecondary institution						
4-year	14.1	55.8	30.1	1.0	18.9	80.1
Less-than-4-year	15.1	52.5	32.4	2.4	38.0	59.6
Not enrolled	17.9	52.0	30.1	9.8	41.6	48.6

[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test.

NOTE: Details for each percentage distribution may not sum to 100 percent because of rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

in a four-year college and enrolling in any postsecondary education. Independent variables included in the models were high school math course taking; whether or not school assistance was received in filling out college applications or preparing for entrance exams; and student, parent, and peer engagement indicators. Also included in the model are parents' education level, whether or not students had aspirations for a bachelor's degree in the tenth grade; and whether they were at least minimally prepared academically to enroll in a four-year college.[36]

Enrollment in a Four-Year College

The results for four-year college enrollment are shown in table 14. In the first column are the unadjusted percentages—the proportion of at-risk students for each row characteristic who enrolled in a four-year college, before controlling for the other variables in the table. The second

[36]It should be noted that even though minimal academic preparation is controlled for in the model, there may be considerable variation within each group (i.e., among those who are prepared and among those who are not prepared).

column displays the corresponding adjusted percentages, for which the variation of all the other variables has been controlled. The italicized row is the comparison group for significance testing. The asterisks indicate instances where a percentage for a specific row is significantly different from the comparison group within the row category. For example, both before and after adjustment, the proportion of at-risk students enrolled in a four-year college was much higher for students who took at least one advanced math course than for at-risk students who took non- or low-academic math courses (5 percent versus 68 percent, unadjusted; 31 percent versus 47 percent, adjusted). Once the other variables are controlled for, the magnitude of the difference between the group taking non- or low-academic math courses and the group taking an advanced course appears smaller, but still remained significant. In contrast, the differences between the other math groups (algebra I/geometry and algebra II) and the comparison group (no higher than low-academic courses) were no longer significant after adjustment (28 to 31 percent). This result may be due to controlling for students' academic preparation. Those who are prepared are more likely to take higher level math courses. For example, as was shown in table 9, nearly all at-risk students who were at least minimally prepared academically to enroll in a four-year college and who aspired to a bachelor's degree had completed algebra I and geometry. Alternatively, for similar reasons, controlling for the educational expectations of students' parents may also account for this result. Those whose parents expect them to earn a bachelor's degree may be more likely to complete math courses through algebra II than students whose parents expect less education.

For the other variables included in the model, the adjusted results differed very little from those found in the tabular analysis (which was limited to at-risk students with aspirations for a bachelor's degree and academically prepared to enroll in a four-year college).[37] As was found in the tabular analysis, two engagement variables had no significant effect on the likelihood of enrolling in a four-year college: students' high school attendance level and parents' educational expectations. Once academic preparation and degree aspirations are controlled for, there is little variation for these indicators. Most students who are academically prepared have parents who expect them to attain a bachelor's degree (see table 12). Similarly, academic preparation is also associated with a higher attendance level.[38] On the other hand, the other student engagement indicator (participating in two or more extracurricular activities compared to participating in none) remained significant with respect to increasing the likelihood of enrollment.

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[37]Note that the unadjusted proportions in table 13 are those for all at-risk students, whereas in the tabular analysis, comparisons were made only for students who had a bachelor's degree goal and were academically prepared. This was done to control for the effect of these variables on college enrollment. In the regression model, however, educational aspirations and academic preparation are included as independent variables.

[38]For example, among academically prepared students, 17 percent had low attendance levels, compared with 25 percent of those not prepared; the opposite pattern was found for high attendance (NELS:88/94 Data Analysis System).

Table 14—Percentage of 1992 high school graduates with one or more risk factors[1] who enrolled in a 4-year institution by 1994, and the adjusted percentage after taking into account the covariation of the variables listed in the table[2]

	Unadjusted percentage[3]	Adjusted percentage[4]	WLS coefficient[5]	Standard error[6]
Total	33.3	33.3	-13.6	2.1
High school math course sequence				
Non- or low-academic	*5.4*	*31.4*	†	†
Algebra I and Geometry	24.0*	31.2	-0.2	2.8
Algebra II	36.1*	27.8	-4.2	2.2
Completed at least one advanced course	67.8*	46.9*	15.4	2.6
School helped with postsecondary application				
Received help	*29.1*	*31.2*	†	†
Did not receive help	42.7*	35.9*	4.7	1.2
Prepared for SAT/ACT				
Did not take a school course	*33.1*	*32.9*	†	†
Took a school course	44.8*	35.8	2.9	1.6
High school class attendance level: 1990				
Low	*24.9*	*32.1*	†	†
Moderate	33.8*	33.3	1.2	1.5
High	41.1*	34.9	2.8	1.9
Extracurricular activities: 1990				
None	*18.0*	*31.5*	†	†
One	31.2*	31.4	-2.7	1.6
2 or more	46.1*	37.2*	5.7	1.8
Parents' educational expectations: 1990				
High school diploma or less	*6.7*	*33.8*	†	†
Some postsecondary education	15.7*	32.2	-1.6	2.8
Bachelor's degree or higher	44.5*	33.8	0.0	2.8
Parents' school-related discussions: 1992				
Infrequent or none	*22.0*	*30.6*	†	†
Moderately frequent	34.0*	33.0	2.4	1.5
Very frequent	47.4*	36.3*	5.6	1.7
Friends: importance of learning activities				
Low	*24.2*	*34.9*	†	†
Moderate	35.2*	34.0	-0.9	1.5
High	40.1*	30.5*	-4.4	1.8
Friends: number who plan 4-year college				
None to some	*18.3*	*27.6*	†	†
Most	51.4*	37.9*	10.3	1.3

Table 14—Percentage of 1992 high school graduates with one or more risk factors[1] who enrolled in a 4-year institution by 1994, and the adjusted percentage after taking into account the covariation of the variables listed in the table[2]—Continued

	Unadjusted percentage[3]	Adjusted percentage[4]	WLS coefficient[5]	Standard error[6]
Parents highest education level				
High school diploma or less	*21.1*	*29.9*	†	†
Some postsecondary education	31.8*	32.0	2.1	1.4
Bachelor's degree or higher	59.1*	41.1*	11.2	1.7
Student's 10th-grade aspirations				
Less than a bachelor's degree	*11.9*	*27.3*	†	†
Bachelor's degree or higher	53.0*	38.2*	10.9	1.5
Academic preparation for 4-year enrollment[7]				
Not prepared	*0.0*	*10.5*	†	†
At least minimally prepared	56.8*	48.2*	37.7	1.5

*$p \leq .05$.

†Not applicable for the reference group.

[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older siblings who dropped out of high school, or held back a grade by 1988.

[2]The italicized group in each category is the reference group being compared.

[3]The estimates are from the NELS:88/94 Data Analysis System.

[4]The percentages are adjusted for differences associated with other variables in the table (see appendix B).

[5]Weighted least squares (WLS) coefficient (see appendix B) multiplied by 100 to reflect a percentage.

[6]Standard error of WLS coefficient, adjusted for design effect (see appendix B) and multiplied by 100 to reflect a percentage.

[7]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test. Note, if students enrolled in a 4-year college and did not meet any of these academic criteria (about 10 percent of those enrolled), they were also coded as academically prepared.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

A change of relationship was found after adjustment for the peer engagement variable that indicates students' perception of the importance that friends attribute to learning activities. Having friends who placed high importance on learning activities actually had a small but significant negative effect on four-year college enrollment, compared to those whose friends placed low importance on learning activities. Before adjustment the relationship was strongly positive: 47 percent of students whose friends placed high importance on learning activities enrolled in a four-year college, compared with 24 percent whose friends placed low importance on them. After adjustment the percentages were 31 percent and 35 percent, respectively. It is not entirely clear

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what caused this reversal in the relationship, but the difference between the two groups is relatively small.

Obtaining help from their school in filling out postsecondary applications still increased the likelihood of students enrolling in a four-year college after adjustment; taking a course to prepare for entrance exams, on the other hand, did not affect enrollment after adjustment. These results were consistent with the tabular analysis that was based only on at-risk students who were academically prepared and aspired to a bachelor's degree.

The parent involvement indicator associated with a higher likelihood of enrolling in a four-year college also remained significant after adjustment. Students whose parents reported having frequent school-related discussions were still more likely to enroll in a four-year college than students whose parents reported infrequent or no discussions.

Finally, even after adjustment, students who reported that most of their friends had plans to attend a four-year college were still more likely to enroll in a four-year college than students who had few or no friends who had college plans.

Enrollment in Any Postsecondary Education

The results for enrollment in any postsecondary education are shown in table 15 and are similar to those found for enrollment in a four-year college with a few exceptions. Unlike four-year college enrollment, participation in any extracurricular activities had no significant effect on whether or not a student enrolled in postsecondary education after adjustment. This may be due to the policy that most four-year colleges require a certain level of participation in extracurricular activities as part of their admissions criteria, while sub-baccalaureate institutions generally have open admission policies. Alternatively, some extracurricular activities may be specifically tailored for students with intentions to enroll in a four-year college.

Another result that differed from that found for four-year college enrollment was for the peer engagement indicator of friends' attitudes toward learning. Both before and after adjustment, the indicator was positively associated with enrolling in any postsecondary education. Students who reported that their friends placed moderate or high importance on such activities were more likely to enroll than those whose friends placed low importance on them.

Also unlike four-year college enrollment, parents' educational expectations for their teen had a positive effect on postsecondary enrollment: compared to having no expectations beyond high school graduation, students whose parents expected them to obtain some postsecondary

education or to graduate from college were more likely to enroll in postsecondary education. In addition, the positive effect of parents having school-related discussions with their teen remained strong for predicting enrollment in any postsecondary education: compared to students whose parents reported infrequent or no school-related discussions, students whose parents reported either moderately or highly frequent discussions were more likely to enroll both before and after adjustment.

Table 15—Percentage of 1992 high school graduates with one or more risk factors[1] who enrolled in any postsecondary education by 1994, and the adjusted percentage after taking into account the covariation of the variables listed in the table[2]

	Unadjusted percentage[3]	Adjusted percentage[4]	WLS coefficient[5]	Standard error[6]
Total	68.0	68.0	-1.904	1.0
High school math course sequence				
Non- or low-academic	*40.1*	*57.3*	†	†
Algebra I and Geometry	63.1*	70.7*	13.5	3.1
Algebra II	73.5*	66.4*	9.1	2.4
Completed at least one advanced course	90.8*	73.9*	16.7	2.9
School helped with postsecondary application				
Received help	*65.5*	*65.1*	†	†
Did not receive help	77.7*	71.3*	6.2	1.3
Prepared for SAT/ACT				
Did not take a school course	*67.3*	*67.2*	†	†
Took a school course	78.6*	71.8	4.6	1.8
High school class attendance level: 1990				
Low	*64.3*	*70.5*	†	†
Moderate	67.9	67.4	-3.1	1.7
High	71.7*	67.2	-3.3	2.1
Extracurricular activities: 1990				
None	*55.5*	*67.5*	†	†
One	66.9*	67.2	-0.3	1.8
2 or more	76.9*	69.3	1.8	2.0
Parents' educational expectations: 1990				
High school diploma or less	*25.2*	*49.3*	†	†
Some postsecondary education	56.4	68.7*	19.4	3.1
Bachelor's degree or higher	77.9*	69.2*	19.9	3.1
Parents' school-related discussions: 1992				
Infrequent or none	*55.4*	*62.9*	†	†
Moderately frequent	68.1*	67.4*	4.5	1.7
Very frequent	81.9*	73.2*	10.3	1.9
Friends: importance of learning activities				
Low	*55.4*	*64.1*	†	†
Moderate	69.7*	68.9*	4.9	1.7
High	76.9*	69.5*	5.4	2.0
Friends: number who plan 4-year college				
Few to some	*58.0*	*64.8*	†	†
Most	81.3	70.4*	5.6	1.5

Table 15—Percentage of 1992 high school graduates with one or more risk factors[1] who enrolled in any postsecondary education by 1994, and the adjusted percentage after taking into account the covariation of the variables listed in the table[2]—Continued

	Unadjusted percentage[3]	Adjusted percentage[4]	WLS coefficient[5]	Standard error[6]
Parents highest education level				
High school diploma or less	*54.7*	*62.6*	†	†
Some postsecondary education	68.0	67.9*	5.3	1.5
Bachelor's degree or higher	89.4*	76.1*	13.5	1.9
Student's 10th-grade aspirations				
Less than a bachelor's degree	*48.6*	*62.2*	†	†
Bachelor's degree or higher	84.4*	72.6*	10.3	1.7
Academic preparation for 4-year enrollment[7]				
Not prepared	*41.1*	*52.3*	†	†
At least minimally prepared	84.4*	78.1*	25.8	1.7

*$p \leq .05$.

†Not applicable for the reference group.

[1]Risk factors include low SES quartile, average grades of C's or lower from sixth to eighth grade, changed schools two or more times (other than natural progression), lived in a single parent family in eighth grade, had one or more older

[2]The italicized group in each category is the reference group being compared.

[3]The estimates are from the NELS:88/94 Data Analysis System.

[4]The percentages are adjusted for differences associated with other variables in the table (see appendix B).

[5]Weighted least squares (WLS) coefficient (see appendix B) multiplied by 100 to reflect a percentage.

[6]Standard error of WLS coefficient, adjusted for design effect (see appendix B) and multiplied by 100 to reflect a percentage.

[7]Based on an index that measures the probability of being academically qualified for a 4-year college. A student is considered minimally prepared if he or she met at least one of the following five criteria: ranked at or above the 54th percentile in one's class, had a GPA of 2.7 or higher in academic courses, had a combined SAT score of 820 or above (or ACT composite of 19 or higher), or scored at the 56th percentile or above on the 1992 NELS math and reading composite aptitude test. Note, if students enrolled in a 4-year college and did not meet any of these academic criteria (about 10 percent of those enrolled), they were also coded as academically prepared.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

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SUMMARY AND CONCLUSIONS

The primary focus of this study was to explore why some students with a family background or early educational experiences that increased their risk of dropping out of high school exhibited considerable resiliency by successfully navigating the pipeline leading to college enrollment. To set the context, comparisons were first made between high school graduates at risk and those not at risk according to the rates at which each group completed five steps leading to college enrollment. These steps included having aspirations in the tenth grade for completing a bachelor's degree, being academically prepared to enroll in college, taking college entrance exams, applying to one or more four-year institutions, and enrolling in a four-year college.

The results indicated that 1992 high school graduates with risk factors associated with dropping out remained at risk with respect to gaining access to higher education. Specifically, students at risk were far less likely to have aspirations for a college degree, and if they did have college aspirations, were less likely to be academically prepared to enroll. While these results are consistent with those from earlier studies, this analysis also found that even at-risk students who navigated the educational system well enough to at least minimally prepare themselves for admission to a four-year college were less likely than their peers not at risk to take the subsequent steps necessary to enroll. That is, academically prepared at-risk students were less likely to take entrance exams, and if they took entrance exams, were less likely to apply to a four-year college. Thus, it appears that some at-risk students who were likely to be admitted, completed the four-year college pipeline at lower rates than their counterparts not at risk (at least within two years of high school graduation).

Furthermore, among students who enrolled in any postsecondary education, students at risk were less likely to exhibit strong indicators of persistence than their counterparts not at risk. This was true both for students who enrolled in a four-year college and for those who enrolled in a community college.

Nevertheless, despite differences that do exist in postsecondary enrollment outcomes between students at risk and those not at risk, approximately one-third of 1992 high school graduates at risk enrolled in a four-year college, and an additional one-quarter enrolled in a public two-year institution. Moreover, among those who enrolled, more than two-thirds exhibited strong indicators of persistence in postsecondary education. How these students differed from their at-risk

counterparts who did not enroll in any postsecondary education by 1994 was next addressed in this report. The analysis also compared students who enrolled in a four-year college with those who enrolled in a subbaccalaureate institution.

Comparisons were made in three areas: completion of math "gatekeeping" courses, the rate at which students reported receiving help from their school in the college application process, and last, the level of school involvement of students, their parents, and their peers. This part of the analysis was limited to students who both aspired to a bachelor's degree and were at least minimally prepared academically to enroll in a four-year college.

Among these students, there were noticeable differences in the level of math courses completed between students who enrolled in a four-year college and those who either enrolled in a subbaccalaureate institution or who did not enroll. While a majority of students had completed a sequence of math courses through algebra II, those who enrolled in a four-year college were much more likely than students who enrolled in other postsecondary education or who had not enrolled to have taken at least one advanced math course such as calculus.

Students who enrolled in a four-year college were also more likely to report receiving help from their school in filling out their application than were students who enrolled in other postsecondary education or who did not enroll. Similar proportions of the latter two groups reported receiving such help.

Finally, the results demonstrated the relative importance of several engagement indicators, especially those for parents and peers. Students who enrolled in a four-year college were more likely than students who did not enroll in any postsecondary education to have parents who reported frequently discussing school-related matters with them. Students who reported that most or all of their friends planned to attend a four-year college were far more likely to enroll in a four-year college themselves than were students who had few or no friends with college plans.

APPENDIX A—GLOSSARY

This glossary describes the variables used in this report. The items were taken directly from the National Education Longitudinal Study (NELS:88/94) Data Analysis System (DAS) (see appendix B for a description of the DAS). The variables used in this analysis were either items taken directly from the NELS surveys or they were derived by combining one or more items in these surveys. For direct survey items, those variable names beginning with "BY" were collected in the base year (1988), "F1" variables were collected in the first followup (1990), F2 in the second followup (1992), and F3 in the third (1994).

The variables listed in the index below are in the order they appear in the report; the glossary is in alphabetical order by DAS variable name (displayed along the right-hand column).

Glossary Index

RISK FACTORS

Changed schools 2 or more times from 1st to 8th grade BYP40
Single parent family ..... BYFCOMP
Lowest socioeconomic quartile ..... BYSES
Older siblings dropped out of high school F1S94
Average grades C's or lower from 6th to 8th grade BYGRD68
Held back one or more grades by 1988 ..... BYS74
Number of risk factors BYRISK2

DEMOGRAPHIC VARIABLES

Gender F3SEX
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PIPELINE VARIABLES

Sequential pipeline steps

Step 1: Bachelor's degree aspirations PIPE1
Step 2: Academically prepared PIPE2
Step 3: Took entrance exams PIPE3
Step 4: Applied to a 4-year college PIPE4
Step 5: Enrolled in a 4-year college PIPE5

Other postsecondary education items

Number of pipeline steps taken ..... PIPESUM
Qualified for a 4-year college ..... PIPEPREP
Enrolled in a 4-year college PIPE4YR
Indicator of postsecondary persistence ..... PSEINDX
Type of first institution F3SEC2A1

MATH COURSE TAKING

Highest level math courses completed MTHQUAL8

HELP FROM SCHOOL WITH POSTSECONDARY APPLICATION

High school help with postsecondary application F2S57A
Exam preparation F2S45A

ENGAGEMENT VARIABLES

Students' class attendance F1ATTEND
Students' extracurricular activities F1EXCUR
Parents' educational expectations F1PAREXP
Parents discuss school-related matters with child F2PTALK
Friends think selected learning activities are important F1FRSTUD
Number of friends who plan to attend a 4-year college F2FRCOLL

Single parent family **BYFCOMP**

Describes the family or household composition. It was constructed from the student responses to items BYS8A-I, taken from the 1988 survey. For this analysis the responses were aggregated as follows:[39]

Single parent family	Household is composed of mother only or father only.
Not from a single parent family	Household is composed of mother and father, mother and male guardian, father and female guardian, or other combination of relatives/guardians.

Average grades C's or lower from 6th to 8th grade **BYGRD68**

Constructed from deciles of grade point averages categorized according to letter grades. For this analysis, the variable was aggregated as follows:

C's or lower grades	Student had average grades of C's or lower from sixth through eighth grade.
Higher than C grades	Student had higher than a C average from sixth through eighth grade.

Changed schools 2 or more times from 1st to 8th grade **BYP40**

In the 1988 survey, parents were asked how many times their eighth grader had changed schools since he or she entered first grade. Changes that occurred as a result of promotion to one grade or level or a move from one elementary school to a middle school in the same district were not counted. This analysis aggregated the number of school changes as follows:

Two or more school changes	Student changed schools two or more times between first and eighth grades.
No more than one school change	Student changed schools between first and eighth grades no more than one time.

Number of risk factors **BYRISK2**

The sum of six possible risk factors including being in the lowest SES quartile and five other risk factors that have been shown to increase the chances of dropping out of high school after controlling for SES and race–ethnicity. Risk factors are as follows:

1. Lowest SES quartile (BYSES)
2. Single parent family (BYFCOMP)
3. Older sibling dropped out of high school (F1S94)

[39]In the DAS, aggregation of a variable is accomplished with the "lumping" tag function (for categorical variables) or the "cut" function for continuous variables.

4. Changed schools 2 or more times (reported by the parent) (BYP40)
5. Average grades of C's or lower from 6th to 8th grades (BYGRD68)
6. Repeated an earlier grade (BYS74)

All of the risk factors were identified as of the eighth grade with the exception of students having older siblings who dropped out of high school, which was asked in the tenth grade. If a student had missing data for two or more risk items, the variable was set to missing. Students with one or more risk factors were considered at risk.

Held back one or more grades by 1988 **BYS74**

A direct question asked of the 1988 eighth grader: Were you ever held back (made to repeat) a grade in school?

Held back	Student was held back a grade in school.
Not held back	Student was never held back a grade in school.

Lowest socioeconomic quartile **BYSES**

A composite measure constructed using the following parent questionnaire data:

Father's education level
Mother's education level
Father's occupation
Mother's occupation
Family income

For cases where all parent data components were missing (8.1 percent of the participants), student data were used to compute the socioeconomic status centile. The variable was aggregated to quartiles for this analysis.

Lowest quartile	Socioeconomic status fell at or below the lowest 25th percentile.
Middle quartiles	Socioeconomic status fell between the 25th percentile and the 75th percentile.
Highest quartile	Socioeconomic status fell at or above the 75th percentile.

Students' class attendance **F1ATTEND**

A measure of students' school attendance, asked in 1990. The variable is based on the following items reported by the student:

How many times late for school (F1S10A)
How many times skipped school (F1S10B)
How many days absent (F1S13)

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The index was aggregated into three categories by percentiles as follows:

Low attendance	Student's attendance value fell below the 25th percentile.
Moderate attendance	Student's attendance value fell between the 25th and 75th percentiles.
High attendance	Student's attendance value fell above the 75th percentile.

Students' extracurricular activities **F1EXCUR**

Number of extracurricular activities in a variety of areas reported by the student in 1990. Includes sports, band, theater, student government, academic societies, yearbook, service clubs, and hobby clubs. The variable was aggregated as follows:

None	Student did not participate in any extracurricular activities.
One	Student participated in one extracurricular activity.
Two or more	Student participated in two or more extracurricular activities.

Friends think selected learning activities are important **F1FRSTUD**

A composite measure of students' peer engagement with respect to the importance of learning activities. Based on the following variables where students indicated how important friends thought it was to:

Attend classes (F1S70A)
Study (F1S70B)
Get good grades (F1S70D)
Finish high school (F1S70F)
Continue education past high school (F1S70I)

Not very important	Students' friends' index of importance for learning fell below the 25th percentile.
Moderately important	Students' friends' index of importance for learning fell between the 25th and 75th percentile.
Highly important	Students' friends' index of importance for learning fell above the 75th percentile.

Parents' educational expectations **F1PAREXP**

Variable was based on the highest educational expectations reported by either the student's father or mother in 1990. For this analysis, the variable was aggregated as follows:

High school diploma or less	Parents expected student to complete no more than a high school diploma.
Some college	Parents expected student to attain some postsecondary education, but short of a bachelor's degree.
Bachelor's degree or higher	Parents expected student to attain a bachelor's degree or higher.

Older siblings dropped out of high school **F1S94**

In the 1990 survey, students were asked how many brothers or sisters (including adopted, step-, or half-siblings) left high school before graduating. For this analysis, the variable was aggregated to:

One or more siblings dropped out	One or more siblings had dropped out of high school.
No siblings dropped out	None of student's siblings were in high school, student was an only child or the oldest, none of student's siblings had dropped out of high school.

Number of friends who plan to attend a 4-year college **F2FRCOLL**

Based on the item BYS69E: "How many of your friends plan to attend a 4-year college?" asked on the 1992 survey.

None	None of student's friends planned to attend 4-year college.
Few to some	Few to some friends planned to attend 4-year college.
Most to all	Most or all of student's friends planned to attend 4-year college.

Parents' highest education level **F2PARED**

This composite variable characterizes the level of education attained by the student's parent with the highest reported education level. It was constructed using the second follow-up parent questionnaire data. New student supplement data were used if parent data were missing. For this analysis, the variable was aggregated as follows:

High school or less	Neither parent completed high school, or at least one parent completed high school or GED.
Some postsecondary education	At least one parent attended some postsecondary education or college, but neither attained a bachelor's degree.
Bachelor's degree or higher	At least one parent was a college graduate, or had attained an advanced degree.

Exam preparation **F2S45A**

In 1992 students were asked if they took a special entrance exam preparation course offered by the school.

Took a course	Student took a special course.
Did not take a course	Student did not take a special course or the school did not offer a course.

High school help with postsecondary application **F2S57A**

In 1992 students were asked if they received help in filling out vocational/technical school or college applications in high school.

Received help	Student received help from the school.
Did not receive help	Student did not receive help or the school did not offer help.

Parents discuss school-related matters with child **F2PTALK**

A composite measure of parent engagement determining how frequently parents discussed school matters with their child. It is based on the following variables: How frequently during the past two years have you and/or your spouse/partner talked about the following with your teenager?

Selecting courses or programs at school (F2P49A)
School activities or events of particular interest to your teenager (F2P49B)
Things your teenager has studied in class (F2P49C)
Your teen's grades (F2P49D)
Plans and preparation for the American College Testing test (ACT), Scholastic Assessment Test (SAT), or Armed Services Vocational Aptitude Battery (ASVAB) (F2P49E)
Applying to colleges or other schools after high school (F2P49F)

The index was coded into quartiles as follows:

Little to no discussion	Parents' index for level of discussion fell below the 25th percentile.
Some discussion	Parents' index for level of discussion fell between the 25th and 75th percentile.
Much discussion	Parents' index for level of discussion fell above the 75th percentile.

Race–ethnicity **F3RACE**

Based on the 1992 value unless it was missing or incorrect. In addition, if it became apparent from responses to other questions that the preloaded value was incorrect, the value was corrected in 1994. Sample members with the value of "Other" were assigned the value -1 (missing).

Asian/Pacific Islander	A person having origins in any of the Pacific Islander peoples of the Far East, Southeast Asia, the Indian subcontinent, or Pacific Islands. This includes people from China, Japan, Korea, the Philippine Islands, Samoa, India, and Vietnam.
Hispanic	A person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.
Black, non-Hispanic	A person having origins in any of the black racial groups of Africa, not of Hispanic origin.
White, non-Hispanic	A person having origins in any of the original peoples of Europe, North Africa, or the Middle East (except those of Hispanic origin).
American Indian/Alaskan Native	A person having origins in any of the original peoples of North America and who maintains cultural identification through tribal affiliation or community recognition.

Type of first institution **F3SEC2A1**

This variable indicates the type of postsecondary institution first attended by the student. The primary source is the SECTOR variable in the 1993/94 Integrated Postsecondary Education Data System (IPEDS) data file. In the few instances where SECTOR is missing, the variable CONTROL from the same file is used. In this report categories were aggregated as follows:

No postsecondary education reported	Student had not enrolled in any postsecondary education by 1994.
4-year institution	Student was enrolled in a public or private, not-for-profit 4-year institution.
Public, 2-year	Student was enrolled in a public 2-year institution.
Other less-than-4-year	Student was enrolled in a public, less-than-2-year institution; a private, not-for-profit less-than-4-year institution; or a private, for-profit institution.

Gender **F3SEX**

Male

Female

Highest level math courses completed **MTHQUAL8**

This variable describes the level of the highest sequence of math courses student completed in high school. It is based on high school transcripts. For this analysis, the variable was aggregated as follows:

No math courses, non-academic or low academic courses	Student did not take any math courses; took non-academic courses including those classified as "general mathematics" or "basic skills mathematics"; low academic courses which comprise preliminary (e.g., pre-algebra) or reduced rigor/pace mathematics courses (algebra I that is spread over two academic years, and "informal geometry").
Completed algebra I and geometry	Completed two years of mathematics including algebra I and geometry, or two years of unified mathematics.
Completed algebra II	An additional year of mathematics was completed including algebra II or a third year of a unified mathematics program.
Completed at least one advanced course	Took at least one of any courses labeled as "advanced," including various trigonometry, probability, statistics, introductory analysis or precalculus, algebra III, or calculus courses.

Step 1: Bachelor's degree aspirations **PIPE1**

The pipeline refers to five consecutive steps usually necessary to enroll successfully in a 4-year college. These steps include:

1. Having aspirations for a bachelor's degree
2. Being academically prepared
3. Taking entrance exams
4. Applying to a 4-year college
5. Enrolling in a 4-year college

Each step was coded based on one or more items in the survey. In addition, a student had to complete all preceding steps to be coded for the next step. For example, to complete step 2, a student had to have a bachelor's degree goal in the tenth grade (step 1) and be academically prepared (step 2). To complete step 3, a student had to have a bachelor's degree goal (step 1), be academically prepared (step 2), and have taken entrance exam (step 3), and so on.

To complete step 1, a student reported having aspirations for a bachelor's degree as of 1990. PIPE1 is based on F1S49, a direct questionnaire item asked of the student in 1990 as follows: As things stand now, how far in school do you think you will get? Those who indicated aspirations for a bachelor's degree were coded as completing STEP 1. If F1S49 was missing and the student had completed all other pipeline steps, student was coded as having completed step 1. If student had completed no other pipeline steps, student was coded as not completing step 1.

Completed	Student took first pipeline step.
Did not complete	Student did not take first pipeline step.

Step 2: Academically prepared **PIPE2**

Completed	Student took the first two steps in the pipeline.
Did not complete	Student did not take the first two steps in the pipeline.

Academic preparation was based on the composite item PIPEPREP (see separate glossary entry for this variable), which identifies students who are qualified to enroll in a 4-year college. If students completed step 1 (had aspirations for a bachelor's degree) and were at least minimally qualified for a 4-year college, they were coded as having completed the first two steps of the pipeline. For more information about pipeline steps see PIPE1.

Step 3: Took entrance exams **PIPE3**

Completed	Student took the first three steps in the pipeline.
Did not complete	Student did not take the first three steps in the pipeline.

Based on the composite EXMAPLY2, which indicates whether or not a student took a SAT and/or ACT exam and applied to a 4-year institution. If EXMAPLY2 was missing, but a student had enrolled in a 4-year institution, they were coded as having taken the exams. If students completed steps 1 and 2 and had taken an entrance exam, they were coded as completing step 3 of the pipeline. For more information about pipeline steps see PIPE1.

Step 4: Applied to a 4-year college **PIPE4**

Completed	Student took the first four steps in the pipeline.
Did not complete	Student did not take the first four steps in the pipeline.

Based on EXMAPLY2, which indicates whether or not a student took a SAT/ACT exam and applied to a 4-year college. If EXMAPLY2 was missing and a student enrolled in a 4-year college, the student was coded as applying. If students completed steps 1 to 3 and had applied to at least one 4-year institution, they were coded as having completed step 4 of the pipeline. For more information about pipeline steps see PIPE1.

Step 5: Enrolled in a 4-year college **PIPE5**

Enrolled	Student took all five pipeline steps and successfully enrolled in a 4-year college.
Did not enroll	Student did not take all five pipeline steps.

Based on the composite PIPE4YR (see separate glossary entry for this variable below). It is a composite of F3SEC2A1 (first institution type) and ENST1092 (enrollment status as of October 1992). If students completed the first four steps of the pipeline and successfully enrolled in any 4-year institution, they were coded as completing all five steps of the pipeline. For more information about pipeline steps see PIPE1.

Qualified for a 4-year college[40] **PIPEPREP**

This variable is based on CQCOMV1, a 4-year college qualification composite variable that indicates whether or not a student was at least minimally qualified to attend a 4-year college. CQCOMV1 was developed using five indicators of academic performance including cumulative GPAs, senior class rank, the NELS 1992 test scores, and the

[40]For further information see L. Berkner and L. Chavez, *Access to Postsecondary Education for the 1992 High School Graduates* (NCES 98-105) (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 1998).

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SAT and ACT college entrance examination scores. Since admission standards and requirements vary widely among 4-year colleges and universities, the approach used the actual distribution of these five measures of academic aptitude and achievement among those graduating seniors who did attend a 4-year college or university. Data sources were available for approximately half (45 percent) of the NELS graduating seniors for four or five of the criteria: class rank, GPA, the NELS 2nd follow-up test, and ACT or SAT scores or both. For about one-third of the seniors only three data sources were available because they had no ACT or SAT scores. In order to identify as many students as possible who were potentially academically qualified for a 4-year college, even if data were missing for these students on some of the criteria, the seniors were classified according to the *highest* level they had achieved on *any* of the five criteria for which data were present. Finally, students who did not meet the minimum criteria but who actually enrolled in a 4-year institution (about 10 percent of 4-year college enrollees) were coded as minimally qualified.[41] If CQCOMV1 was missing (about 10 percent of high school graduates), a student who had indicated bachelor's degree aspirations, taken entrance exams, applied to college, and enrolled was coded as academically qualified (5 percent recoded). Conversely, if CQCOMV1 was missing and a student had done none of the above, the student was coded as not qualified (1.7 percent recoded).

For this analysis, the variable was aggregated as follows:

At least minimally prepared	Students whose highest value on any of the five criteria would put them among the top 75 percent (i.e., in the third quartile) of 4-year college students for that criterion. Minimum values were GPA=2.7, class rank percentile=54, NELS test percentile=56, combined SAT=820, composite ACT=19. If students did not meet the minimum criteria, but enrolled in a 4-year college, they were coded as prepared.[42]
Not prepared academically	Did not meet any of the minimum criteria and did not enroll in a 4-year college.

Enrolled in a 4-year college **PIPE4YR**

This variable is based on type of first postsecondary institution (F3SEC2A1), and indicates whether or not a student first enrolled in a 4-year college. In about 5 percent of cases, F3SEC2A1 was missing, and for these students, their enrollment status as of October 1992 was used (ENST1092). PIPE4YR differs from PIPE5 in that it is based on all students. PIPE5, on the other hand, is a cumulative variable based on students having bachelor's degree aspirations, being academically qualified, taking entrance exams, and applying to a 4-year college.

4-year college	Student's first postsecondary institution was a 4-year college.
Not a 4-year college	Student's first postsecondary institution was not a 4-year college.

[41]These students may have met the admissions criteria for a specific institution without meeting the general academic criteria. In addition, students who enrolled without having met the academic criteria had fewer of the original five measures on which qualification was based (see the Berkner and Chavez report cited above for more information).

[42]Note that in the Berkner and Chavez report, students who did not meet the minimal criteria for the five academic indicators were coded as marginally or not qualified. The variable they used for their analysis (CQCOMV2) is available in the DAS.

Number of pipeline steps taken **PIPESUM**

Refers to the total number of steps taken in a path toward enrolling in a 4-year college (from 0–5) regardless of whether they were taken in sequence. The steps include reporting a bachelor's degree goal in the tenth grade, being academically prepared, taking entrance exams, applying to a 4-year college, and enrolling in a 4-year college.

Indicator of postsecondary persistence **PSEINDX**

For students who enrolled in postsecondary education, this variable indicates whether or not they enrolled full time within one year after high school graduation and attended continuously from first enrollment (i.e., all periods of non-enrollment were shorter than four months). In this analysis, it was used to indicate how likely students were to persist to degree attainment.

Strong persistence indicators	Student enrolled full time within one year of high school graduation and attended continuously.
Other	Student delayed enrollment, started part time, or had non-continuous enrollment.

APPENDIX B—TECHNICAL NOTES AND METHODOLOGY

THE NATIONAL EDUCATION LONGITUDINAL STUDY OF 1988

The National Education Longitudinal Study of 1988 (NELS:88) is a survey that began with a nationally representative sample of 1988 eighth graders and followed them every two years. The most recent follow-up survey occurred in 1994. Respondents' teachers and schools were also surveyed in 1988, 1990, and 1992, while parents were surveyed in 1988 and 1992. In contrast to previous longitudinal studies, NELS:88 began with eighth graders in order to collect data regarding the transition from elementary to secondary education. The first follow-up in 1990 provided the data necessary to understand the transition. Dropouts were administered a special survey to understand the dropout process more thoroughly. For the purpose of providing a comparison group to 1980 sophomores surveyed in High School and Beyond, the NELS:88 sample was also "freshened" with new participants who were tenth graders in 1990.

In spring of 1992, when most of the NELS:88 sample were twelfth graders, the second follow-up took place. This survey focused on the transition from high school to the labor force and postsecondary education. The sample was also "freshened" in order to create a representative sample of 1992 seniors for the purpose of conducting trend analyses with the 1972 and 1982 senior classes (NLS-72 and HS&B). Students identified as dropouts in the first follow-up were also resurveyed in 1992. In spring of 1994, the third follow-up was administered. Sample members were questioned about their labor force and postsecondary experiences, and family formation. For more information about the NELS:88 survey, consult the NELS:88/94 Methodology Report.[43]

ACCURACY OF ESTIMATES

The statistics in this report are estimates derived from a sample. Two broad categories of error occur in such estimates: sampling and nonsampling errors. Sampling errors occur because

[43]U.S. Department of Education, National Center for Education Statistics, *National Education Longitudinal Study (NELS:88/94) Methodology Report* (NCES 96-174) (Washington D.C.: 1996).

observations are made only on samples of students, not on entire populations. Nonsampling errors occur not only in sample surveys but also in complete censuses of entire populations. Nonsampling errors can be attributed to a number of sources: inability to obtain complete information about all students in all institutions in the sample (some students or institutions refused to participate, or students participated but answered only certain items); ambiguous definitions; differences in interpreting questions; inability or unwillingness to give correct information; mistakes in recording or coding data; and other errors of collecting, processing, sampling, and imputing missing data.

DATA ANALYSIS SYSTEM

The estimates presented in this report were produced using the NELS:88/94 Data Analysis System (DAS). The DAS software makes it possible for users to specify and generate their own tables from the NELS:88/94 data. With the DAS, users can replicate or expand upon the tables presented in this report. In addition to the table estimates, the DAS calculates proper standard errors and weighted sample sizes for these estimates.[44] For example, table B1 contains standard errors that correspond to table 2 in the text, and was generated by the DAS. If the number of valid cases is too small to produce a reliable estimate (less than 30 cases), the DAS prints the message "low-N" instead of the estimate.

In addition to tables, the DAS will also produce a correlation matrix of selected variables to be used for linear regression models. Included in the output with the correlation matrix are the design effects (DEFTs) for each variable in the matrix. Since statistical procedures generally compute regression coefficients based on simple random sample assumptions, the standard errors must be adjusted with the design effects to take into account the NELS:88 stratified sampling method. (See discussion under "Statistical Procedures" below for the adjustment procedure.)

[44]The NELS:88/94 sample is not a simple random sample and, therefore, simple random sample techniques for estimating sampling error cannot be applied to these data. The DAS takes into account the complexity of the sampling procedures and calculates standard errors appropriate for such samples. The method for computing sampling errors used by the DAS involves approximating the estimator by the linear terms of a Taylor series expansion. The procedure is typically referred to as the Taylor series method.

For more information about the NELS:88/94 and other Data Analysis Systems, consult the NCES DAS Website (**WWW.PEDAR-DAS.org**) or contact:

Aurora D'Amico
NCES Data Development and Longitudinal Studies Group
555 New Jersey Avenue, NW
Washington, DC 20208-5652
(202) 219-1365
Internet address: Adamico@ed.gov

Table B1—Standard errors for table 2: Percentage of 1992 high school graduates with each risk factor, by number of risk factors and all other risk factors

	Changed schools two or more times from 1st to 8th grade	Lowest SES quartile	Average grades C's or lower from 6th to 8th grade	Single parent family	Older sibling(s) dropped out of high school	Held back one or more grades from 1st to 8th grade
Total	0.71	0.66	0.57	0.56	0.44	0.46
Number of risk factors						
Any risk factors	1.01	1.01	0.90	0.89	0.70	0.77
One risk factor	1.26	0.93	0.89	1.00	0.62	0.58
Two risk factors	1.62	1.57	1.61	1.48	1.47	1.50
Three or more	2.17	2.57	2.42	2.48	2.58	2.56
Number of school changes from 1st to 8th grade						
Two or more times	0.00	1.16	1.34	1.36	0.96	1.24
Less than two	0.00	0.68	0.58	0.57	0.44	0.43
Socio-economic status 1988						
Lowest quartile	1.46	0.00	1.20	1.47	1.22	1.15
Middle to high quartiles	0.78	0.00	0.62	0.58	0.40	0.49
Average grades from 6th to 8th grade						
C's or lower	1.92	1.45	0.00	1.71	1.19	1.71
A's or B's	0.72	0.67	0.00	0.55	0.45	0.42
Family composition in 1988						
Single parent family	2.08	1.81	1.85	0.00	1.36	1.88
Other than single parent	0.72	0.65	0.57	0.00	0.44	0.42
Older siblings who left high school						
One or more	1.93	1.89	1.62	1.72	0.00	1.78
None left or no siblings	0.76	0.63	0.62	0.60	0.00	0.48
Student ever held back a grade						
Yes	2.43	1.91	2.30	2.34	1.80	0.00
No	0.73	0.64	0.52	0.55	0.40	0.00

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

STATISTICAL PROCEDURES

Two types of statistical procedures were employed in this report: testing differences between means, and adjustment of means after controlling for covariation among a group of variables. Each procedure is described below.

Differences Between Means

The descriptive comparisons were tested in this report using Student's t statistic. Differences between estimates are tested against the probability of a Type I error, or significance level. The significance levels were determined by calculating the Student's t values for the differences between each pair of means or proportions and comparing these with published tables of significance levels for two-tailed hypothesis testing.

Student's t values may be computed to test the difference between estimates with the following formula:

$$t = \frac{E_1 - E_2}{\sqrt{se_1^2 + se_2^2}} \tag{1}$$

where E_1 and E_2 are the estimates to be compared and se_1 and se_2 are their corresponding standard errors. Note that this formula is valid only for independent estimates. When the estimates are not independent (for example, when comparing a total percentage with that for a subgroup that is included in the total), a covariance term must be added to the formula. If the comparison is between the mean of a subgroup and the mean of the total group, the following formula is used:

$$\frac{E_{sub} - E_{tot}}{\sqrt{se_{sub}^2 + se_{tot}^2 - 2p\ se_{sub}^2}} \tag{2}$$

where p is the proportion of the total group contained in the subgroup.[45]

When comparing two percentages from a distribution that adds to 100 percent, the following formula is used:

$$\frac{E_1 - E_2}{\sqrt{Se_1^2 + Se_2^2 - 2rSe_1^2Se_2^2}} \tag{3}$$

[45]U.S. Department of Education, National Center for Education Statistics, *A Note from the Chief Statistician*, No. 2, 1993.

where r is the correlation between the two estimates.[46] The estimates, standard errors, and correlations can all be obtained from the DAS.

There are hazards in reporting statistical tests for each comparison. First, comparisons based on large t statistics may appear to merit special attention. This can be misleading, since the magnitude of the t statistic is related not only to the observed differences in means or percentages but also to the number of students in the specific categories used for comparison. Hence, a small difference compared across a large number of students would produce a large t statistic.

A second hazard in reporting statistical tests for each comparison occurs when making multiple comparisons among categories of an independent variable. For example, when making paired comparisons among different levels of income, the probability of a Type I error for these comparisons taken as a group is larger than the probability for a single comparison. When more than one difference between groups of related characteristics or "families" are tested for statistical significance, one must apply a standard that assures a level of significance for all of those comparisons taken together.

Comparisons were made in this report only when $p \leq .05/k$ for a particular pairwise comparison, where that comparison was one of k tests within a family. This guarantees both that the individual comparison would have $p \leq .05$ and that for k comparisons within a family of possible comparisons, the significance level for all the comparisons will sum to $p \leq .05$.[47]

For example, in a comparison of the percentages of students at risk to those not at risk who enrolled in postsecondary education only one comparison is possible (at-risk versus not-at-risk students). In this family, $k=1$, and the comparison can be evaluated without adjusting the significance level. When students are divided into five racial–ethnic groups and all possible comparisons are made, then $k=10$ and the significance level of each test must be $p \leq .05/10$, or $p \leq .005$. The formula for calculating family size (k) is as follows:

$$k = \frac{j(j-1)}{2} \qquad (4)$$

[46]Ibid.

[47]The standard that $p \leq .05/k$ for each comparison is more stringent than the criterion that the significance level of the comparisons should sum to $p \leq .05$. For tables showing the t statistic required to ensure that $p \leq .05/k$ for a particular family size and degrees of freedom, see Olive Jean Dunn, "Multiple Comparisons Among Means," *Journal of the American Statistical Association* 56 (1961): 52–64.

where j is the number of categories for the variable being tested. In the case of race–ethnicity, there are five racial–ethnic groups (American Indian, Asian/Pacific Islander, black non-Hispanic, Hispanic, and white non-Hispanic), so substituting 5 for j in equation 2,

$$k = \frac{5(5-1)}{2} = 10$$

Adjustment of Means to Control for Background Variation

Tabular results are limited by sample size when attempting to control for additional factors that may account for the variation observed between two variables. For example, when examining the percentages of those who completed a degree, it is impossible to know to what extent the observed variation is due to socioeconomic status (SES) differences and to what extent it is due to differences in other factors related to SES, such as type of institution attended, intensity of enrollment, and so on. However, if a nested table were produced showing SES within type of institution attended, within enrollment intensity, the cell sizes would be too small to identify the patterns. When the sample size becomes too small to support controls for another level of variation, one must use other methods to take such variation into account.

To overcome this difficulty, multiple linear regression was used to obtain means that were adjusted for covariation among a list of control variables.[48] Adjusted means for subgroups were obtained by regressing the dependent variable on a set of descriptive variables such as parents' education, students' academic preparation, students' educational aspirations, etc. Substituting ones or zeros for the subgroup characteristic(s) of interest and the mean proportions for the other variables results in an estimate of the adjusted proportion for the specified subgroup, holding all other variables constant. For example, consider a hypothetical case in which two variables, race–ethnicity and income, are used to describe an outcome, Y (such as attending a four-year college). The variables race–ethnicity and family income are recoded into a dummy variable representing race–ethnicity and a dummy variable representing family income:

Race–ethnicity	R
Black students	1
Non-black students	0

[48]For more information about weighted least squares regression, see Michael S. Lewis-Beck, *Applied Regression: An Introduction*, Vol. 22 (Beverly Hills, CA: Sage Publications, Inc., 1980); William D. Berry and Stanley Feldman, *Multiple Regression in Practice*, Vol. 50 (Beverly Hills, CA: Sage Publications, Inc., 1987).

and

Family income	*F*
Low income	1
Not low-income	0

The following regression equation is then estimated from the correlation matrix output from the DAS:

$$\hat{Y} = a + b_1 R + b_2 F \quad (5)$$

To estimate the adjusted mean for any subgroup evaluated at the mean of all other variables, one substitutes the appropriate values for that subgroup's dummy variables (1 or 0) and the mean for the dummy variable(s) representing all other subgroups. For example, suppose we had a case where Y was being described by race–ethnicity (*R*) and family income (*F*), coded as shown above, and the means for *R* and *F* are as follows:

Variable	Mean
R	0.109
F	0.282

Suppose the regression equation results in:

$$\hat{Y} = 0.51 + (0.032)R + (-0.21)F \quad (6)$$

To estimate the adjusted value for black students, one substitutes the appropriate parameter values into equation 4.

Variable	Parameter	Value
a	0.510	—
R	0.032	1.000
F	-0.210	0.282

This results in:

$$\hat{Y} = 0.51 + (0.032)(1) + (-0.21)(0.282) = 0.48 \quad (7)$$

In this case the probability of attending a four-year college for black students is 0.48 and represents the expected outcome for black students who look like the average student across the other variables (in this example, family income). In other words, the adjusted percentage who enrolled in a four-year college is 48 percent (0.48 x 100 for conversion to a percentage).

It is relatively straightforward to produce a multivariate model using the DAS, since one of the DAS output options is a correlation matrix, computed using pairwise missing values.[49] This matrix can be used by most statistical software packages as the input data for least-squares regression. That is the approach used for this report, with an additional adjustment to incorporate the complex sample design into the statistical significance tests of the parameter estimates (described below). For tabular presentation, parameter estimates and standard errors were multiplied by 100 to match the scale used for reporting unadjusted and adjusted percentages.

Most statistical software packages assume simple random sampling when computing standard errors of parameter estimates. Because of the complex sampling design used for the NELS:88/94 survey, this assumption is incorrect. A better approximation of their standard errors is to multiply each standard error by the average design effect of the independent variable (DEFT),[50] where the DEFT is the ratio of the true standard error to the standard error computed under the assumption of simple random sampling. It is calculated by the DAS and produced with the correlation matrix.

---

[49]Although the DAS simplifies the process of making regression models, it also limits the range of models. Analysts who wish to use other than pairwise treatment of missing values or to estimate probit/logit models (which are the most appropriate for models with categorical dependent variables) can apply for a restricted data license from NCES. See John H. Aldrich and Forrest D. Nelson, *Linear Probability, Logit and Probit Models* (Quantitative Applications in the Social Sciences, Vol. 45) (Beverly Hills, CA: Sage University Press, 1984).

[50]The adjustment procedure and its limitations are described in C.J. Skinner, D. Holt, and T.M.F. Smith, eds., *Analysis of Complex Surveys* (New York: John Wiley & Sons, 1989).

APPENDIX C—SUPPLEMENTARY TABLES

Table C1—Percentage of 1992 high school graduates who enrolled in a 4-year institution by 1994, and the adjusted percentage after taking into account the covariation of the variables listed in the table[1]

	Unadjusted percentage[2]	Adjusted percentage[3]	WLS coefficient[4]	Standard error[5]
Total	42.9	42.9	-56.2	7.2
Family composition in 1988				
Single parent family	37.3*	36.2*	-6.9	3.4
Other than single parent	*46.1*	*43.1*	†	†
Average grades from 6th to 8th grade				
C's or lower	15.3*	18.6*	-29.2	1.4
A's or B's	*50.7*	*47.8*	†	†
Number of school changes from 1st to 8th grade				
Less than two	38.1*	38.7*	-5.7	1.3
Two or more times	*25.5*	*16.0*	†	†
Student ever held back a grade				
Yes	19.4*	26.5*	-18.5	1.7
No	*49.1*	*45.0*	†	†
Socio-economic status 1988				
Lowest quartile	20.7*	24.1*	-23.0	1.4
Middle to high quartiles	*50.0*	*47.1*	†	†
Older siblings who left high school				
One or more	24.6*	30.9*	-12.4	0.0
None left or no siblings	*47.6*	*43.3*	†	†

*$p \leq .05$.

†Not applicable for the reference group.

[1]The italicized group in each category is the reference group being compared. They are slightly different from the percentages in table 5 because they are based on a dichotomous variable with fewer missing cases.

[2]The estimates are from the NELS:88/94 Data Analysis System.

[3]The percentages are adjusted for differences associated with other variables in the table (see appendix B).

[4]Weighted least squares (WLS) coefficient (see appendix B) multiplied by 100 to reflect a percentage.

[5]Standard error of WLS coefficient, adjusted for design effect (see appendix B) multiplied by 100 to reflect a percentage.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

Table C2—Percentage of 1992 high school graduates who enrolled in any postsecondary education by 1994, and the adjusted percentage after taking into account the covariation of the variables listed in the table[1]

	Unadjusted percentage[2]	Adjusted percentage[3]	WLS coefficient[4]	Standard error[5]
Total	75.1	75.1	9.0	8.4
Family composition in 1988				
Single parent family	71.4*	81.7*	6.8	3.0
Other than single parent	*77.1*	*74.9*	†	†
Average grades from 6th to 8th grade				
C's or lower	53.8*	56.7*	-22.1	1.2
A's or B's	*80.7*	*78.8*	†	†
Number of school changes from 1st to 8th grade				
Two or more times	73.9*	74.3	-1.1	1.0
Less than two	*77.7*	*75.4*	†	†
Student ever held back a grade				
Yes	55.8*	26.5*	-16.0	1.5
No	*79.7*	*76.9*	†	†
Socio-economic status 1988				
Lowest quartile	53.2*	55.6*	-23.9	1.2
Middle to high quartiles	*81.2*	*79.5*	†	†
Older siblings who left high school				
One or more	59.9*	66.3*	-12.4	2.9
None left or no siblings	*78.9*	*75.4*	†	†

*$p \leq .05$.

†Not applicable for the reference group.

[1]The italicized group in each category is the reference group being compared.

[2]The estimates are from the NELS:88/94 Data Analysis System.

[3]The percentages are adjusted for differences associated with other variables in the table (see appendix B).

[4]Weighted least squares (WLS) coefficient (see appendix B).

[5]Standard error of WLS coefficient, adjusted for design effect (see appendix B).

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94), Data Analysis System.

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Table C3—Among 1992 high school graduates who did not enroll in a 4-year college, the percentage who took various combinations of pipeline steps

	Pipeline steps				
	Bachelor's degree goal	Academically prepared	Took exams	Applied to 4-year college	Percent
Total					100.0
Took no steps					25.6
Took one step					24.8
	•				8.4
			•		8.2
		•			7.4
				•	0.8
Took two steps					19.8
		•	•		6.2
	•		•		5.7
	•	•			5.2
			•	•	1.8
	•			•	0.8
		•		•	0.1
Took three steps					18.0
	•	•	•		10.5
	•		•	•	3.8
		•	•	•	3.3
	•	•		•	0.4
Took four steps	•	•	•	•	11.7

•Took step

NOTE: This table represents all high school graduates who did not enroll in a 4-year college with respect to the number of pipeline steps taken. For each number of steps, the total percent who took that number of steps appears at the top of the "percent" column for that group. For those who took one to three steps, the percent taking various combinations is shown below the total percent. For example, 19.8 percent took two steps, consisting of 6.2 percent who were academically prepared and took exams, 5.7 percent who had a bachelor's degree goal and took exams, 5.2 percent who had a degree goal and were academically prepared, and so on.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study (NELS:88/94).

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